APPENDIX B

Water Quality Technical Materials

San Francisco Bay Area Environmental Management Plan

June 1978

This plan was prepared by the Association of Bay Area Governments with a grant and other assistance from the Environmental Protection Agency, in cooperation with Bay Area Air Pollution Control District, Metropolitan Transportation Commission, San Francisco Bay Regional Water Quality Control Board and Counties of the Bay Area with assistance of these agencies: ■ Army Corps of Engineers ■ California Air Resources Board ■ California Department of Health ■ California Department of Transportation ■ Council of Bay Area Resource Conservation Districts ■ Governor's Office of Planning and Research ■ Lawrence Berkeley Laboratory ■ Lawrence Livermore Laboratory ■ San Francisco Bay Conservation and Development Commission ■ State Water Resources Control Board ■ State Solid Waste Management Board ■ Wastewater Solids Study

ABAG

WATER QUALITY MANAGEMENT PLAN

LIST OF TECHNICAL MATERIALS

WQMP/TECHNICAL MEMORANDA

- Technical Memorandum 1 - "Preliminary Candidate Control Measures for Municipal and Industrial Discharges, Non-point Sources Other Than Urban Runoff and Water Conservation, Reuse and Supply," January 1977.
- Technical Memorandum No. 2 - "Review of Existing Laws, Policies and Requirements for the Pretreatment or Treatment of Industrial Wastes," July 1978.
- Technical Memorandum No. 3 - "Significant Discrete Industrial Dischargers," January 1977.
- Technical Memorandum No. 4 - "Septic Tank Systems - The Problem and Possible Solutions," May 1978.
- Technical Memorandum No. 5 - "Existing and Planned Wastewater Management Facilities in the San Francisco Bay Region," June 1977.
- Technical Memorandum No. 6 - "Vessel Wastes - The Problem and Possible Solutions," December 1977.
- Technical Memorandum No. 7 - "Equivalent Heavy Metals Loading Factors; Present Point Source Heavy Metals Loading Rates in the Bay Region 208 Planning Area," February 1977.
- Technical Memorandum No. 8 - "Existing Municipal Wastewater Management Agencies in the San Francisco Bay Region," February 1977.
- Technical Memorandum No. 9 - "Financing Municipal Wastewater Facilities," February 1977.
- Technical Memorandum No. 10 - "Public Financing of Industrial Wastewater Abatement," February 1977.
- Technical Memorandum No. 13 - "Preliminary Reclaimed Wastewater Market Survey," April 1977.
- Technical Memorandum No. 14 - "Preliminary Water-use Projections for the Bay Area," April 1977.
- Technical Memorandum No. 15 - "Estimated Municipal and Non-discrete Industrial Wastewater Loads in the San Francisco Bay Region," June 1977.
- Technical Memorandum No. 17 - "Significance of Pollution Problems Resulting From the Extraction of Mineral Resources," May 1977.
- Technical Memorandum No. 18 - "Estimated Industrial Wastewater Loads in the San Francisco Bay Region," May 1977.

- Technical Memorandum No. 20 - "Salt Intrusion into Groundwaters," December 1977.
- Technical Memorandum No. 21 - "Further S.F. Bay Modeling Results," July 1977.
- Technical Memorandum No. 22 - "Oil and Chemical Spills," March 1978.
- Technical Memorandum No. 23 - "Further S.F. Bay Modeling Results - II," August 1977.
- Technical Memorandum No. 24 - "Dredging and Spoil Disposal," August 1977.
- Technical Memorandum No. 26 - "Estimated Costs of Treating Industrial Discharges," October 1977.
- Technical Memorandum No. 27 - "Effects of Water Conservation Upon Wastewater Treatment," February 1978.
- Technical Memorandum No. 28 - "Recommendations on Maintenance of Outflow Rates from the Sacramento - San Joaquin Delta," November 1977.
- Technical Memorandum No. 29 - "Estimated Effects of the Draft Air Quality Maintenance Plan Recommendations Upon Water Quality," January 1978.
- Technical Memorandum No. 30 - "Estimated Municipal and Non-discrete Industrial Wastewater Loads as Affected by Various Population Projections," January 1978.
- Technical Memorandum No. 31 - "Proposed Strategy for Pretreatment of Industrial Wastes Discharged to Municipal Sewer Systems," March 1977.
- Technical Memorandum No. 32 - "An Estimate of the Economic Value of Shellfish in San Francisco Bay," January 1978.
- Technical Memorandum No. 33 - "Water Quality Problems in San Francisco Bay," January 1978.

Technical Memoranda Nos. 11, 12, 16, 19 and 25 are not included because they were superseded by later technical memoranda.

WQMP/ISSUE PAPERS

- Issue Paper No. 1, "Water Quality Analysis and Pollution Control Strategies," December 1976.
- Issue Paper No. 2, "Pretreatment of Industrial Wastes Discharged to Municipal Sewer Systems," January 1977.

WQ/Tech Memo 1/7/77

Peter Chiu, Don Hemovich, John Davis

WATER QUALITY MANAGEMENT PLANS

PRELIMINARY CANDIDATE CONTROL MEASURES FOR MUNICIPAL AND INDUSTRIAL DISCHARGES, NON-POINT SOURCES OTHER THAN URBAN RUNOFF AND WATER CONSERVATION, REUSE AND SUPPLY

TECHNICAL MEMORANDUM No. 1

INTRODUCTION

The purpose of this memorandum is to provide a preliminary listing of candidate control measures for use in the evaluation and assessment and public participation tasks. It is recognized that, due to the complex interrelationships between plan elements, control measures in one element, municipal facilities for example, may duplicate or otherwise influence control measures for another element such as water conservation, reuse and supply. In addition, because substantial efforts have been made already in the field of water pollution control some of the control measures listed are in the process of implementation.

MUNICIPAL WASTEWATER FACILITIES PLAN CONTROL MEASURES

The candidate control measures for municipal wastewaters fall into three groups.

A. Measures to reduce wastewater volume and pollutant content at the domestic or commercial source.

B. Measures to treat wastewater and reuse or dispose of wastewater effluent.

C. Measures to control land use.

A. Measures to reduce wastewater volume and pollutant content

1. Restrict availability of toxic materials. Restrict the commercial availability of inessential toxic chemicals for household use.

2. Control the use of household appliances. Prohibit or restrict the use of household appliances that adversely influence wastewater strength and volume, e.g., garbage grinders, water softeners.

3. Reduce wastewater volumes by water conservation. Reduce wastewater generation by adopting water conserving practices such as low flush volume toilets, faucet aeration, etc.

4. Control infiltration and inflow. Control and reduce excessive infiltration and inflow into sewage collection facilities.

5. Adopt household water reuse practices. Install household plumbing systems that allow reuse of lightly polluted household wastewaters as sources of landscape irrigation water.

6. Conduct public awareness programs. Conduct education and information programs to increase public awareness of wastewater disposal problems.

B. Measures to treat, reuse and dispose of wastewaters.

1. Construct, enlarge and improve wastewater treatment facilities. Construct, enlarge or improve community or sub-regional treatment facilities.

2. Construct effluent dispersion facilities. Construct facilities to convey treated effluent to suitable receiving water bodies and effect adequate dispersion.

3. Construct reuse facilities. Construct facilities to convey effluent to areas with a demand for reclaimed water.

4. Adopt measures to force/encourage wastewater reuse. Adopt measures that will force or encourage the use of reclaimed water whenever it is available and is an adequate substitute for an existing water use.

5. Construct storage facilities to prevent combined sewage overflows. Construct storage facilities within combined sewage collection systems to reduce peak flows at overflow locations.

C. Measures to control land use

1. Control development patterns. Encourage compact development to reduce the need for sewage collection facilities.

2. Relate zoning to effectiveness of individual wastewater treatment systems. Relate zoning and permissible lot sizes to soil or other conditions that determine the effectiveness of individual waste treatment systems.

3. Prohibit new development. Prohibit new development in areas where wastewaters cannot be disposed of without unacceptable damage to environmental values.

4. Restrict new development. Restrict new development in areas where existing arrangements for sewerage service do not maintain compliance with waste discharge standards.

INDUSTRIAL DISCHARGE PLAN CONTROL MEASURES

The candidate control measures for industrial discharges are of a regulatory nature.

1. Prohibit discharges in certain areas. Probibit discharges to certain areas of bay and ocean where they are incompatible with other beneficial uses.

2. Impose more stringent discharge requirements. Impose more stringent requirements on discrete industrial wastewater discharges to upgrade effluent quality.

3. Impose more stringent pre-treatment requirements. Impose more stringent pre-treatment requirements on non-discrete industrial discharges to eliminate difficult-to-treat pollutants from the municipal sewage system.

OTHER NONPOINT SOURCE CONTROL MEASURES

The candidate control measures for other non-point sources of pollution are described with reference to each pollutant source.

A. Agriculture (Crops)

1. Adopt more efficient irrigation practices. Adopt irrigation practices that allow water applications to be closely adjusted to crop and soil leaching needs in order to minimize return flows.

2. Adopt soil conservation practices. Adopt practices that reduce soil erosion, such as contour farming, conservation-oriented crop rotation systems, and crop residue management.

3. Control agricultural chemical application rates. Control closely application rates of fertilizers, pesticides and herbicides to minimize quantities of chemicals available for flushing into the ground or surface waters.

4. Restrict use of agricultural chemicals. Restrict the use of non-readily degradable pesticides and herbicides.

5. Collect and treat irrigation return flow. Collect return flows from large areas in agricultural drains and manage as point sources of pollutants.

B. Agriculture (Animal Husbandry)

1. Adopt runoff management practices. Adopt practices that minimize generation of polluted runoff at feedlots and dairies by recycling wash waters, grading around manure stockpiles, etc.

2. Collect and treat polluted runoff, wash water, etc. Collect polluted runoff and manage as a point source of pollutants.

3. Restrict animal access to watercourses. Fence streams to prevent uncontrolled animal watering.

4. Adopt range management practices. Adopt range management practices that prevent over-grazing and soil erosion.

C. Forestry

1. Adopt soil-conserving harvesting practices. Adopt harvesting practices that do not denude the harvested area of all runoff retaining vegetation.

2. Establish performance standards for logging haul roads. Establish design criteria for logging haul raods that embody measures to prevent soil erosion.

3. Revegetate graded areas. Seed and replant graded areas to rapidly reestablish vegetative cover.

4. Construct temporary sediment traps. Construct temporary sediment traps downstream of logging activities to trap and remove sediment.

D. Mining and Construction

1. Adopt runoff management practices. Provide ditches, berms and conduits to route runoff around exposed cut and fill slopes and mine tailings.

2. Construct sediment traps. Provide settling basins downstream of construction or mining sites to trap and remove sediment.

3. Revegetate graded areas. Seed graded areas to rapidly reestablish vegetative cover.

4. Adopt hazardous material management practices. Adopt procedures for the safe disposal of waste materials from construction activities, e.g., waste oil and fuel, asbestos-containing compounds, paints, etc.

5. <u>Restrict slope and drainage practices</u>. Develop codes restricting maximum cut and fill slopes and establishing drainage requirements.

E. <u>Individual Waste Disposal Systems</u>

1. <u>Restrict the use of septic tanks</u>. Prohibit the use of septic tanks/leach fields in areas where soil type and topography make them functionally ineffective.

2. <u>Establish/design criteria for septic tanks</u>. Establish design criteria for septic tanks and leaching fields that are logically related to soil permeability, slope, etc.

3. <u>Establish septic tank maintenance and inspection programs</u>. Establish programs for inspecting and certifying the performance of septic tank/leach field systems.

4. <u>Establish performance standards for alternative individual waste disposal systems</u>. Establish performance standards for individual waste disposal systems other than septic tanks, e.g.composting toilets, vaults, etc.

5. <u>Construct facilities for handling septic tank pumpings at municipal treatment plants</u>.

F. <u>Dredging Operations</u>

1. <u>Restrict dredging operations temporarily.</u> Prohibit dredging operations in certain areas during periods of fish migration and spawning.

2. <u>Designate dredge spoil disposal sites</u>. Designate dredge spoil disposal sites in bay and ocean suitable for disposal of different types of dredged material.

3. <u>Monitor dredge spoil quality</u>. Monitor dredge spoil quality and assign to appropriate disposal sites.

G. <u>Vessel Wastes</u>

1. <u>Construct waste handling facilities at docks</u>. Construct sewer hook-ups or waste holding tanks at docks.

2. <u>Construct waste handling facilities at houseboat berths</u>. Construct systems for handling wastes from semi-permanently moored vessels.

3. Require segregation of vessel wastes. Restrict the type of wastes that may enter vessel sanitary systems to those compatible with the municipal wastewater treatment facilities which they will ultimately enter.

4. Prohibit the discharge of waste in certain areas. Prohibit the discharge of waste in certain areas either comprehensively (i.e., within the 3-mile limit) or within specific areas (i.e., the vicinity of bathing beaches or shellfish beds).

H. Aerial Fallout

This diffuse source of pollutants will be addressed in the Air Quality Maintenance Plan.

I. Solid Waste and Wastewater Treatment Residuals Disposal Activities

Control measures for these sources of pollutants will be developed in the Solid Waste Management Plan and San Francisco Bay Region Municipal Wastewater Solids Study.

WATER CONSERVATION, REUSE AND SUPPLY CONTROL MEASURES

Control measures for this plan element are divided into two groups: water conservation and supply; and reuse.

A. Water Conservation and Supply

1. Restrict development of new supply sources. Prohibit development of new supply sources unless the developer has an effective water conservation program.

2. Modify water supply rate structures. Modify rate structures to encourage water conservation.

3. Install low water-use fittings in new homes. Install low water-use shower heads and toilets and faucet aerators in all new homes.

4. Detect and repair leaks. Detect and repair leaks in distribution system and provide assistance to consumers in detecting and repairing in-house leaks.

5. Install low water-use fittings in existing homes. Install retrofit water saving devices in existing homes.

6. Adopt low-water consuming landscaping practices. Require low-water consuming landscaping at all new commercial or governmental buildings. Encourage residential adoption of low-water consuming landscaping.

7. Conduct public information program. Conduct programs to increase public awareness of water use and conservation.

8. Adopt water conserving irrigation practices. Adopt irrigation practices (spray or drip) that minimize irrigation losses and allow applications to be closely matched with crop needs.

9. Adopt water-saving industrial processes and practices. Adopt industrial and commercial processes, in-plant reuse and good housekeeping practices that minimize water use.

B. Water Reuse

1. Require the use of reclaimed water under certain circumstances. Require the use of reclaimed water by industry or agriculture if reclaimed water adequately meets quality requirements for a particular use and if State Health Department regulations can be complied with.

2. Adopt measures to encourage wastewater reuse. Adopt measures to encourage use of reclaimed water by industry and agriculture even when such use may involve some changes in agricultural or industrial practices.

3. Impose true cost of wastewater treatment on industrial and agricultural dischargers. Impose true cost of wastewater treatment on dischargers to encourage in-plant and in-farm water reuse.

4. Adopt household water reuse practices. Install household plumbing systems that allow reuse of lightly polluted household wastewaters as sources of landscape irrigation water.

WQ/Tech Memo 2/October 76
H.J. Naftzger/Bursztynsky

WATER QUALITY MANAGEMENT PLANS

REVIEW OF EXISTING LAWS, POLICIES AND REQUIREMENTS FOR THE PRETREATMENT OR TREATMENT OF INDUSTRIAL WASTES

TECHNICAL MEMORANDUM NO. 2
OCTOBER 12, 1976
REVISED JULY 5, 1978

Treatment for discrete industrial sources (where effluent is discharged to a receiving water) and pretreatment for nondiscrete sources (where waste is discharged to a municipal system for further treatment) are closely related topics. There is, however, an important administrative difference between requirements for pretreatment and requirements for treatment.

All entities (including industries) discharging pollutants to a receiving water are subject to regulation directly by Federal and State agencies through a discharge permit system, under Federal law. Nondiscrete industrial sources are also subject to Federal requirements; but because they do not discharge to the environment, no discharge permit is required under Federal or State law. The actual administration of requirements on a nondiscrete industrial source must be performed by the local agency which operates the treatment plant receiving that waste.

The following review is organized by government entity, from the U.S. Congress to local operating agencies. Significant changes (in brackets) resulting from PL 95-217, enacted December 27, 1977, are included as appropriate. These changes have not yet been incorporated by local operating agencies.

I. United States Congress: per PL 92-500, "Federal Water Pollution Control Act Amendments of 1972"

   A. Treatment of Industrial Wastes Discharged to Environment (Discrete Industrial Sources)

      - All wastes from discrete sources must be treated at least to the level of best practicable technology by 1977, best available technology by 1983. (Sec. 301)

      [Best available technology must be instituted within 3 years after adoption by EPA of effluent standards, but not later than July 1, 1984 for a list of select toxicants (Sec. 301).]

[EPA shall establish effluent limitations for non-municipal point sources no later than July 1, 1984. (Sec. 301)]

- The Environmental Protection Agency shall publish guidelines describing best practicable and best available technology for treatment of wastes from non-public sources, by industrial category. (Sec. 304)

- Where required in order to protect beneficial uses of the receiving waters, effluent limitations shall be more stringent than those given above. (Sec. 302)

- For new sources, EPA shall formulate effluent standards reflecting best available technology. (Sec. 306)

B. Pretreatment of Industrial Wastes Introduced into Publicly-Owned Systems (Nondiscrete Industrial Sources)

- EPA shall promulgate standards for pretreatment of wastes from nondiscrete sources, to control pollutants not susceptible to treatment in publicly-owned plants or otherwise incompatible with such works. Standards will be issued by industrial category. All affected sources must be in compliance within three years of promulgation of the applicable standard. (Sec. 307)

- For new nondiscrete sources, EPA shall issue effluent standards in conjunction with those for discrete sources. (Sec. 307)

[Pretreatment requirements may be modified to reflect removal of toxic pollutants by public treatment works. (Sec. 307)]

C. Action by States; Administration

- The states shall adopt effluent limitations and compliance schedules at least as stringent as those described above. (Sec. 303)

- Pollutants may be discharged to the environment only in conformance with the provisions of this Act.(Sec. 301) EPA is authorized to issue permits for the discharge of pollutants under the National Pollutant Discharge Elimination System. Such permits must specify all applicable conditions which the discharge must satisfy. This permit authority may be delegated to individual states. (Sec. 402)

II. U. S. Environmental Protection Agency

A. Treatment of Wastes from Discrete Industrial Sources

EPA has issued a series of regulations which constitute effluent guidelines and standards for various industrial categories. These are contained in the Code of Federal Regulations, Title 40, Parts 401 to 460 (40 CFR 401-460). At this time there are regulations for 40 different industrial categories. Each category typically is divided into a number of subcategories; in some cases subcategories are further subdivided.

Effluent limitations on existing industrial sources, conforming to "best practicable technology" and "best available technology," are termed guidelines. Effluent limitations on new sources are termed standards. (Requirements for pretreatment, also covered by these regulations, are also termed standards. Pretreatment requirements are discussed separately, below.)

For some industrial categories the basic regulation has been issued all at once; for others, it has been issued by parts, at different times. For most, if not all, categories amendments subsequent to the original issue have been necessary.

The Congress, in PL 92-500, specified 28 industrial categories for which EPA would issue effluent guidelines and standards, and directed EPA to include other categories as required. Regulations covering at least portions of all the original 28 categories are now in effect, together with 12 additional categories. Apparently EPA intends to issue regulations for still other categories.

Many of the regulations appear to be essentially complete in their coverage. Others are not complete; for example:

- For the forming and finishing segment of the iron and steel industry, only "best practicable technology" guidelines are final; regulations for "best available technology," new sources, etc., are currently in "proposed" status.

- For the meat products industry, no regulations have been issued for the poultry segment.

- For the inorganic chemicals industry, regulations for manufacture of a number of specific chemicals have not been issued; space has been reserved for these in the numbering system.

- For the organic chemicals industry, the only regulation currently in place covers manufacture of butadiene. Guidelines and standards for a number of other subcategories had been issued earlier but were withdrawn in April of this year because of apparently faulty supporting data.

Typically, the guidelines for a given industrial subcategory sets pollutant discharge limits in terms of unit mass emission rates for specific appropriate pollutant parameters. (The unit mass emission rate is the amount of pollutant discharged for each unit, say 1,000 pounds of basic industrial production.) Effluent limits are given for existing sources for "best practicable technology" (1977 compliance) and "best available technology" (1983 compliance). The latter is ordinarily more stringent than the former, sometimes markedly so. For some subcategories, zero discharge of pollutants is the requirement under one or both technologies.

The regulations for most industrial categories also include effluent standards for new sources. Sec. 306 of PL 92-500 appears to require "best available technology" for new sources, although there are nuances

of language which may distinguish "best available technology" for new sources from that for existing sources (secs. 301 and 304). In any case, the requirements for new sources are, for some categories or subcategories, equal to "best available technology" for existing sources; for some cases, equal to "best practicable technology"; and for some cases, intermediate between the two. There are also a few anomalous cases, e.g., a few subcategories in the seafood industry, where "best available technology" for existing sources is less stringent than "best practicable technology," or where new source limits are less stringent than any existing source limits.

B. Pretreatment of Wastes from Nondiscrete Industrial Sources, Prior to Introduction into Publicly-Owned Systems

EPA has issued a general regulation, 40 CFR 128, "Water Programs - Pretreatment Standards." This regulation provides the following:

- States and local agencies may establish requirements more stringent or otherwise not in conflict with this regulation.

- "Compatible pollutants" are defined as BOD, suspended solids, pH and fecal coliform bacteria, together with any other pollutants which a publicly-owned treatment works has been designed and is operated to treat effectively. "Incompatible pollutants" are all those not compatible.

- A major contributing industry is defined as one with a flow exceeding 50,000 GPD or 5% of the flow of the receiving municipal system, one whose waste contains a toxic pollutant in toxic amounts, or one whose waste otherwise has or contributes to a significant impact on the receiving treatment works or its effluent.

- All industries introducing waste flows into public systems are prohibited from including wastes which pose a fire or explosion hazard, wastes which will cause corrosive damage, wastes which can cause obstruction to pipes or interference with processes, and wastes having such peaks of flow or pollutant loading as to produce process upsets.

- This regulation does not require pretreatment for removal of compatible pollutants. State and local agencies may require such treatment.

- Major industries, as defined above, will be subject to effluent limitations for specific noncompatible pollutants. EPA will promulgate these limitations for each industrial category as part of the effluent guidelines and standards for that industry. Industries must be in compliance within three years of date of promulgation of the pretreatment standard for that category. Pretreatment standards can be relaxed on an individual basis to the extent that the receiving treatment works is committed to treating for the pollutant(s) involved.

Present status of pretreatment standards for specific industries is as follows:

- For existing sources, EPA has standards for roughly one-third to one-half of industrial subcategories; the others remain to be issued. The standards issued are essentially all for industries which do not emit incompatible pollutants. The standards typically consist of the specific application of regulation 40 CFR 128 (above), with paragraphs relating to the definition of compatible and incompatible pollutants and their treatment deleted. Relevant compatible pollutants are by name assigned "no limitation" for discharge to the receiving system. For a very few industries, possibly incompatible pollutants are assigned "no limitation": cement industry, waste heat; soap and detergent industry, surfactants. Generalized waste prohibitions given in 40 CFR 128 remain in force. Most standards remaining to be issued will have to address the problem of incompatible pollutants. Some proposed standards issued recently do include limits on applicable incompatibles (e.g., rolling mill segment of the iron and steel industry.)

- For new sources, EPA has issued pretreatment standards for most industries for which treatment requirements also exist. Thus, for many subcategories, pretreatment has been specified for new sources but not for existing ones. For many industrial categories, new source treatment standards are applied to pretreatment, with relaxation of standards allowed where justified by receiving works performance. This type of provision has been made both for subcategories having compatible wastes only and for some having incompatible wastes. For a number of subcategories releasing compatible pollutants, "no limitation" is assigned. For some subcategories having incompatible wastes, specific limits different from new source treatment standards are given.

- EPA proposed regulations for industrial pretreatment in February 1977. These regulations included four alternative pretreatment strategies. Following public hearings and passage of PL 95-217, a single, modified strategy has been adopted (CFR, Vol. 43, No. 123, June 26, 1978). It is as follows:

  There will be a program of Federally based, technology standards for 21 industrial categories and general discharge prohibitions for pollutants harmful to or incompatible with municipal treatment works. "EPA will, in this round of standard setting, concentrate categorical standards on (65) pollutants which now appear most toxic or hazardous." "These categorical pretreatment standards will contain numerical pollutant discharge limitation...based upon the best available technology economically achievable (BAT)." "...a pollutant which is found to be incompatible, but is not included on a list of toxic or hazardous substances, will be covered by section 304(g) guidance... to be used by State and local governments to establish their own pretreatment limits." "Modification of the pollutant

discharge limits in categorical pretreatment standards by (municipal facilities) will be authorized for documented removal of pollutants attained by (municipal facility) if a pretreatment program has been developed" and modification is consistent with sludge disposal requirements. Where a municipal pretreatment program is developed, the municipality will be responsible for enforcement of national standards.

C. Summary

- Treatment of wastes from discrete sources: regulations are in effect for most industrial subcategories, but a number remain to be completed, issued, or revised and reissued. Those not complete are mainly among the more difficult wastes.

- Pretreatment of wastes from nondiscrete sources: for existing sources, regulations have been issued primarily only for wastes which are compatible with municipal plant processes; few, if any, difficult wastes have been covered. For new sources, a greater number of industrial subcategories has been covered, including a number of difficult wastes, but many still remain not covered. In many of the pretreatment standards which have been issued, primarily under the new source heading, an element of discretion has been introduced in allowing relaxation of industrial effluent requirements in recognition of receiving municipal treatment plant capabilities.

III. California Legislature: per "Porter-Cologne Act", as amended

The quality of the waters of the State shall be so regulated as to be the highest reasonable, considering all demands and uses. The State Water Resources Control Board has primary responsibility within the State for water quality and is the policy-making body in this area. The State is divided into nine water quality regions, with a Regional Water Quality Control Board for each region. The Regional Boards have administrative responsibility for water quality planning and control within their respective regions. The discharge of wastes into the waters of the State is defined as a privilege, not a right.

In order to implement the provisions of Federal PL 92-500, the State Board and Regional Boards are mandated to issue waste discharge requirements (discharge permits) to dischargers, as authorized by that Act. Provisions generally, including compliance schedules, are in accordance with PL 92-500.

IV. California State Water Resources Control Board

The State Board issues regulations in the field of water quality control (California Administrative Code, Title 23, Waters, Chapter 3.) These regulations require all dischargers to file a report of waste discharge (discharge permit application) with the appropriate Regional Water Quality Control Board. The Regional Board will then formulate discharge requirements for each discharger in accordance with the provisions of PL 92-500. The permit will also include such items as compliance schedules, reporting requirements and a self-monitoring program.

The State Board, then, has adopted the detailed effluent requirements formulated by EPA for application to local municipal and industrial

dischargers. (Where gaps exist in the detailed requirements, the State Board has not attempted to fill them) Discrete industrial sources discharging to receiving waters are regulated directly by the Regional Boards. Nondiscrete sources discharging to municipal systems must be regulated by the local agencies involved, through local source control programs.

To assist in local regulation of nondiscrete sources, the State Board has also issued "Guidelines for Determining Effectiveness of Local Source Control Programs" (June 1976). While this document is more than its title implies, it is a guideline in that it provides discretionary, not mandatory, guidelines (in contrast with use EPA has made of the word "guideline".) The "Guidelines" describe a good local source control program as containing the following:

- A local ordinance for control of industrial wastes entering the collection system.
- A use permit program.
- A surveillance program.
- A correction and enforcement program.

A suggested list of pollutants of concern is included, but no quantitative limits of any kind are given. The suggested elements of a source control program are discussed in some detail.

V. Regional Water Quality Control Boards

The Regional Boards have direct responsibility for regulating municipal dischargers and discrete industrial dischargers. This is done through issuance of discharge permits, under the National Pollutant Discharge Elimination System mandated by PL 92-500. For discrete industrial sources, the discharge permit typically includes the following major items:

- Limitations on discharge of appropriate pollutant parameters.
- Requirements on the condition of the receiving water.
- Time schedule for compliance, including a number of intermediate steps.
- Requirements for a self-monitoring and reporting program. Monitoring is carried out on both effluent and receiving water.

Limitations imposed on effluents conform closely to EPA regulations. Requirements on receiving water quality are obtained from planning mandated by PL 92-500.

Nondiscrete industrial sources are approached through the discharge permits issued to municipal dischargers. These permits are quite similar to those described above for industrial dischargers, with the addition of the requirement that the local agency institute a source control program to assure compliance of nondiscrete industrial sources with Federal standards. Regional Board requirements for source control programs include:

- The local agency must require compliance by all industrial contributors with applicable Federal pretreatment standards. For existing dischargers, compliance shall be within three years of promulgation of the standard involved. (As noted previously, standards for many industries have not yet been issued.) New sources must comply from startup with previously existing regulations.

- The local agency must institute a monitoring and reporting system covering all industrial sources included in the source control program.

The ABAG Environmental Management Plan Water Quality Study Area is covered by two Regional Boards: The San Francisco Bay Regional Board is responsible for most of the area; the Central Valley Regional Board is responsible for areas in Eastern Contra Costa and Solano Counties.

VI. Local Operating Agencies - Publicly-Owned Treatment Works

Operating agencies typically impose a source control program through a local ordinance or code governing sewer use, industrial waste discharges, etc. Ordinances currently in effect in the Bay Area vary substantially between agencies, depending on local needs and viewpoints. There is considerable activity at present in reviewing and updating sewer control ordinances. The "Model Wastewater Discharge Ordinance" was prepared in October 1975 by the California Water Pollution Control Association; this has been adopted essentially intact by several agencies.

The need for a source control program varies markedly between agencies. Many small agencies receive sewage only from residences and commercial establishments and have no industrial sources to regulate. Large agencies, such as East Bay Municipal Utility District, San Francisco, and others, may have as many as sixty or more industrial contributors which qualify as major sources, thus requiring regulation.

Local agencies have two sets of conditions to meet in instituting a source control program for industrial contributors:

- The specific permit requirement for a source control program which will impose Federal pretreatment standards on industrial sources.

- Discharge requirements on the effluent from the municipal plant. The industrial wastes accepted cannot impair the performance of the municipal plant.

Where Federal pretreatment requirements are lacking, local agencies must formulate guidelines for industrial contributors based on their own plant capabilities and effluent limitations. The Model Ordinance of the CWPCA does provide guidance in this regard. Among its provisions are detailed limitations on discharge to the system of various deleterious materials, including oil and grease, chlorinated hydrocarbons, phenols, and a number of heavy metals. Unlike EPA regulations, which are written for specific industries, the Model Ordinance is written as a blanket coverage. The Model Ordinance does refer to the necessity of conforming also with EPA regulations which are in effect.

At this time, implementation of source control programs is underway but not complete. The current lack of Federal pretreatment standards in many

industrial categories does not appear to pose serious practical problems for the local agencies. It appears now that local source control will be operational in the Bay Area within a reasonably short time.

VII. Summary

The "Federal Water Pollution Control Act Amendments of 1972," PL 92-500, is the primary legal instrument in the field of wastewater management. Federal regulations issued by the Environmental Protection Agency provide supporting detail. Specific requirements for treatment of wastes from discrete industrial sources are essentially complete for many industrial sources and well advanced for others. Requirements for pretreatment of nondiscrete sources are rather far from complete.

State law (The "Porter-Cologne Act," as amended) and regulations issued by the State Water Resources Control Board adopt Federal law and regulations and apply them to wastewater management in the State. Regional Water Quality Control Boards have direct administrative responsibility for application of requirements to municipal and discrete industrial dischargers, through the discharge permit program.

Discharge permits issued by the Regional Boards to municipal dischargers not only set effluent limitations but require also that these agencies institute source control programs for significant industrial contributors to their systems. Where Federal pretreatment standards are lacking, local agencies formulate regulations for industrial contributors based on their own plant capabilities and effluent requirements.

WQ/Tech Memo 3/January 77
J. Naftzger

Water Quality Management Plans

Significant Discrete Industrial Dischargers

Technical Memorandum No. 3
January 19, 1977

Discrete industrial discharges are those in which industrial wastes, treated to the degree necessary, are released directly to a receiving water. This is in contrast to non-discrete discharges, where industrial effluents are directed to a municipal collection and treatment system.

This paper consists primarily of a tabulation (Table 1) and location map (Figure 1) of significant discrete industrial dischargers in the San Francisco Bay Area. The list was obtained from a review of discharge permits issued to industries, primarily by Regional Water Quality Control Boards. These are issued under the National Pollutant Discharge Elimination System provided for by the Federal Water Pollution Control Act of 1972. In general, the criteria for inclusion of industries in the list are as follows:

- Industries with flows of cooling water only, equal or greater than 0.2 mgd

- Industries with flows including process water, equal to or greater than 0.1 mgd.

Some discretion has been used in including or excluding certain industries:

- Several operations have been excluded which handle dredged bay sand. Sand is unloaded hydraulically from barges, resulting in a return flow to the bay. The return flow is subject to fairly strict suspended solids limits and is typically passed through a settling pond to meet those requirements. Since the return flow consists of a return of bay water and a small amount of bay sediment to the bay, it was considered to be not significant.

- Shipyards have been included in this list. No waste flows per se are permitted to be discharged from shipyards. However, in the

normal fill-and-drain operation of dry docks, a certain amount of extraneous material removed from ship hulls, such as metal, paint and dead marine organisms, is washed into the bay. Shipyards are required now to practice good housekeeping in the operation of dry docks, and the amount of such material reaching the bay is fairly well minimized.

- Discharge permits have been issued to a number of industrial firms whose primary or only discharge consists of storm runoff. In many cases such wet-weather discharges are from plant areas that may contribute process-related pollutants, and the permits include restrictions on discharge of such pollutants. However, it was decided to consider these discharges as storm runoff rather than as industrial discharges.

This tabulation is considered to be essentially complete in most respects. The principal exception is in the Antioch area where major dischargers are listed but complete data has not yet been obtained. (Antioch comes under the jurisdiction of the Central Valley Regional Board rather than the Bay Regional Board which covers most of the study area.)

TABLE I

SAN FRANCISCO BAY REGION - ENVIRONMENTAL MANAGEMENT PROGRAM
Water Quality/Technical Memorandum 3

SIGNIFICANT DISCRETE INDUSTRIAL DISCHARGERS

Code No.	Discharger	Location[1)]	Activity	Flow Mgd	Waste Description
	ALAMEDA COUNTY				
101	Alameda Co. Water District	Newark-Fremont	Water supply	29	Brackish groundwater
102	Campbell Chain Co.	Union City	Chain mfg.	0.3	Cooling water
103	Cerro Metal Products	Newark	Brass products	0.1	Process & cooling water
104	Colgate-Palmolive Co.	Berkeley	Soaps, detergents	0.5	Cooling water
105	De Laval Turbine Co.	Oakland	Metal castings	1.4	Scrubber water
106	Del Monte Corporation	Oakland	Fruit, vegetable canning	0.2	Cooling water
107	FMC Corporation[2)]	Newark	Phosphates	1.2	Process & cooling water
108	General Electric Co.	Pleasanton	Radioisotopes	0.3	Sewage & cooling water
109	Gerber Products Co.	Oakland	Fruit, vegetable & meat canning	0.7	Cooling water
110	Kaiser Aerospace & Electronics	San Leandro	Missile & Aircraft Parts	0.3	Process & cooling water
111	Leslie Salt Co.[3)]	Newark	Salt production	0.6	Saturated brine
112	Merritt Ship Repair Co.	Oakland	Shipyard	--	Drydock flushing
113	Morton Salt Co.	Newark	Salt refining	0.3	Cooling water
114	Todd Shipyard Co.	Alameda	Shipyard	--	Drydock flushing

Code No.	Discharger	Location	Activity	Flow Mgd	Waste Description
	CONTRA COSTA COUNTY				
201	Allied Chemical Corp.	Nichols (Pittsburg)	Industrial chemicals	3.6	Process & cooling water
202	California & Hawaiian Sugar Company	Crockett	Sugar refining	33	Process & cooling water
203	Crown Zellerbach	Antioch			
204	Dow Chemical, U.S.A.	Pittsburg	Chemicals	25	Process & cooling water
205	E.I. DuPont de Nemours and Co.	Antioch			
206	Fibreboard Corp. - Antioch Plant	Antioch			
207	Fibreboard Corp. - San Joaquin Plant	Antioch			
208	Hickmott Foods Inc.	Antioch			
209	Kaiser Gypsum Co., Inc.	Antioch			
210	Lion Oil Co.	Avon (Martinez)	Oil refining	12	Process & cooling water
211	Nicolai-Joffe Corp.	Richmond	Ship dismantling	0.1	Ship ballast water
212	Pacific Gas & Electric Co.	Antioch	Electric power generation		
213	Pacific Gas & Electric Co.	Avon (Martinez)	Electric power generation	0.3	Cooling water
214	Pacific Gas & Electric Co.	Martinez	Electric power generation	0.3	Cooling water

Code No.	Discharger	Location	Activity	Flow Mgd	Waste description
215	Pacific Gas & Electric Co.	Oleum (Rodeo)	Electric power generation	54	Cooling water
216	Pacific Gas & Electric Co.	Pittsburg	Electric power generation	632	Cooling water
217	Pacific Refining Co.	Hercules	Oil refining	0.2	Process water
218	Shell Oil Co.	Martinez	Oil refining	5.2	Process & cooling water
219	Standard Oil Co. of California	Richmond	Oil refining	120	Process & cooling water
220	Stauffer Chemical Co.	Martinez	Mfg. acid	0.3	Process & cooling water
221	Stauffer Chemical Co.	Richmond	Industrial chemicals & herbicides	0.1	Process & cooling water
222	Tillie Lewis Foods, Inc.	Antioch			
223	Union Oil Co.	Oleum (Rodeo)	Oil refining	45	Process & cooling water
224	United States Steel Corp.	Pittsburg	Steel forming	22	Process & cooling water
225	Valley Nitrogen Producers, Inc. 4)	Hercules	Nitrogen fertilizers	1.7	Process water
226	Virginia Chemicals Inc.	Selby (Crockett)	Sulfur dioxide	1.0	Process & cooling water
227	Willamette Iron & Steel Co.	Richmond	Shipyard	--	Drydock flushing

Code No.	Discharger	Location	Activity	Flow Mgd	Waste description
	SOLANO COUNTY				
301	Exxon Co., U.S.A.	Benicia	Oil refining	3.6	Process & cooling water
302	Mare Island Naval Station	Mare Island (Vallejo)	Shipyard	--	Drydock flushing
	NAPA COUNTY				
401	Kaiser Steel Corp.	Napa	Steel plate and shipyard	--	Drydock flushing
	SONOMA COUNTY				
501	Hein Bros. Basalt Rock Co.	Petaluma	Gravel crushing	0.2	Aggregate washing
	MARIN COUNTY				
601	Basalt Rock Co.	Pt. San Pedro (San Rafael)	Gravel crushing	0.8	Aggregate washing
	SAN FRANCISCO CO.				
701	Bethlehem Steel Corp.	Potrero	Shipyard	--	Drydock flushing
702	Pacific Gas & Electric Co.	Hunters Point	Electric power generation	284	Cooling water
703	Pacific Gas & Electric Co.	Potrero	Electric power generation	360	Cooling water

Code No.	Discharger	Location	Activity	Flow Mgd	Waste description
704	Treasure Island Naval Station	S.F. Bay	Navy base	2.0	Domestic & industrial
705	Triple-A Machine Shop	Hunters Point	Shipyard	--	Drydock flushing
	SAN MATEO COUNTY				
801	E.I. du Pont de Nemours & Co.	So. San Francisco	Paints & thinners	0.4	Cooling water
802	Marine World-Africa USA	Redwood City	Zoological park	13	Lagoon circulation
803	Merck & Co.	So. San Francisco	Magnesium products	5.2	Process water
804	San Francisco International Airport	San Bruno	Aircraft maintenance	1.2	Industrial wastes
	SANTA CLARA COUNTY				
901	General Electric Co.	San Jose	Instrument Mfg.	0.2	Cooling water
902	Lockheed Missiles & Space Co.	Sunnyvale		0.2	Cooling water

Footnotes

1) See Fig. 1 for Location Map.
2) Process waste discharge prohibited after July 1977.
3) Waste currently being ponded.
4) Waste treatment and discharge to be integrated in West County System.

WQ/Tech Memo 4 /May 1977

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WATER QUALITY MANAGEMENT PLANS

SEPTIC TANK SYSTEMS - THE PROBLEM AND POSSIBLE SOLUTIONS

TECHNICAL MEMORANDUM NO. 4

Revised May, 1977

Revised May, 1978

INTRODUCTION

During the formative years of the older Bay Area cities severe health problems were caused by the high density of individual waste disposal systems, which were usually pit privies. In the latter part of the last century most larger communities raised funds and built publicly-owned sewage collection systems to replace the old privies. Thus, for the last one hundred years the trend has been away from individual waste disposal systems.

There is little doubt that construction of community sewage systems resulted in a dramatic improvement in public health, second only to the improvement wrought by the provision of community water supplies. However, as frequently happens with technological trends, an initially innovative approach to a problem meets with early success, builds up momentum and subsequently is applied as a panacea in inappropriate circumstances. Costly sewage collection systems have been built in some rural or suburban communities, the waste disposal needs of which might have been served by well-maintained individual systems.

The Environmental Protection Agency has, in the past, inadvertently participated in a bias against individual domestic wastewater disposal systems through the public works grant programs. By providing grant funds towards trunk sewers, centralized sewage treatment plants, and disposal facilities while not providing funds towards individual systems, the EPA created a local attitude favoring grant eligibile alternatives. This situation is changing as EPA modifies the grant eligibility of certain elements and types of individual systems.

The purpose of the management plan for individual waste disposal systems is not to advocate the more frequent use of such systems. It is to advocate that such systems should be considered and used when they represent the most appropriate waste disposal system for a particular circumstance.

This technical memorandum describes some of the problems associated with the use of septic tanks, the most commonly applied individual disposal system, and outlines some possible solutions to these problems.

Septic Tank Systems in the Bay Area

The 1970 Census (U.S. Dept. of Commerce, 1970) gives some statistics on the type of sewage disposal used by county. These statistics are listed for the Bay Area in the following Table.

TABLE 1: TYPE OF SEWAGE DISPOSAL USED
BY BAY AREA HOUSEHOLDS

County	Number of Households			
	Public Sewer	Septic tank or cesspool	Other	Total
Alameda	374,924	4,316	476	379,716
Contra Costa	165,521	12,492	325	178,338
Marin	64,312	6,009	253	70,574
Napa	19,569	7,135	84	26,788
San Francisco	309,282	430	666	310,378
San Mateo	184,617	5,266	228	190,111
Santa Clara	312,858	22,824	467	336,149
Solano	49,073	4,231	133	53,437
Sonoma	45,502	31,353	419	77,274
Bay Area Total	1,525,658	94,056	3,051	1,622,765

Septic tank and cesspool systems are the most widely used form of individual sewage disposal, accounting for 5.8% of the households, as opposed to 0.2% using other means. Thus, it is reasonable to assume that a study of problems with individual home sewage disposal should be an analysis of septic tank system practices.

Operation of Septic Tank Systems

Septic tank systems consist of two separate parts--a septic tank and a soil absorption system. The septic tank is a large underground container in which initial settling and anaerobic treatment of the wastewater occurs. The soil absorption system is a leach field, trench system, or pit. Septic tank effluent flows into the soil absorption system and moves through the surrounding soil, where it is filtered and aerobically treated by the soil.

Bacteria and fungi in the soil digest organic pollutants while soil particles either absorb or physically filter most organic and mineral pollutants. Certain pollutants, such as the nitrate ion, can pass through soil more freely than phosphate, ammonium or organic matter. The efficiency of septic tanks depends upon loading, storage capacity for settleable matter, grease traps and a design to dissipate the energy of flowing wastewater. The efficiency of a soil absorption system depends greatly upon the physical and chemical nature of the soil, its porosity, ground water conditions, rainfall and physical size and configuration of the leach field.

WATER QUALITY PROBLEMS ASSOCIATED WITH SEPTIC TANK SYSTEMS

Properly functioning septic tank systems provide on-site disposal of wastewater in a manner that does not adversely affect the environment or the public health. Water quality and health problems associated with their use are usually the product of failing systems, with the exception of passage of nitrate through the soil and into the ground water.

Septic tank disposal systems can fail in a number of ways. When they do fail, the effects may be wastewater travelling through the soil too rapidly or reaching the ground surface, ground water, or surface water in too short a distance to accomplish pollutant removals, or wastewater backing up in the household plumbing system.

The water quality problems that result from failure are of varying degrees of severity. Clogging or too short a time in the soil can lead to partially treated effluent forming ponds on the surface or flowing to a nearby stream. If effluent reaches the ground or surface water, it can lead to bacterial contamination, high nutrient and nitrate loadings, and high detergent concentrations. Current water quality problems related to septic tank system failures are poorly documented. However, such problems are thought to exist in the following areas:

- Conn Creek and the Lake Hennessey watershed in Napa County
- Stinson Beach on Bolinas Lagoon in Marin County
- Livermore, Oakland Hills, Hayward Hills, Happy Valley, Buena Vista Ave., and Bella Roma Ave. in Alameda County
- Emerald Lakes area in the watershed of Redwood City in San Mateo County
- Edgerly Island in Napa County
- A further listing is provided in appendix Table C

Because of the poor documentation of water quality problems or of failures, it is not possible to prove conclusively whether the problems are due to isolated, relatively random failures in the area or to failures of all or a large percentage of the systems in the area. This is due partially to a reluctance of individual homeowners, faced with potentially large sewer connection charges, to report septic tank system problems.

If the ponded effluent is not noticed, as may be the case during the winter rainy season, body contact with effluent may occur and can lead to disease transmission. The extent of the health problem is difficult to document because it usually consists of an unreported increased transmission of disease within a single household or local neighborhood. Inadequately treated effluent can also lead to the contamination of well water. Although the health problems that result from contaminated water supply are severe, according to staff members of County Health Departments, cases of contamination are rare and localized.

The cumulative effect of too many systems in a single ground water basin may be a build-up of nitrates in the ground water. Nitrate nitrogen concentrations in excess of 10 mg/l in drinking water have been confirmed to cause an infant blood disorder known as infant methemoglobinemia. Water supply well monitoring programs (Calif. Dept. of Water Res., 1974-1975) have found wells in the Suisun-Fairfield, Clayton Valley, Livermore, Half Moon Bay Terrace, Pescadero, and Santa Clara Valley areas that exceed the federal drinking water standard of 10 mg/l of nitrogen. These problems may be due to excessive use of septic tank systems, but an exact correlation has not been established scientifically. There is a high correlation for the Livermore area.

Soil Limitations On The Use of Septic Tank Systems

Many of the problems that could be associated with the use of septic tank systems in the Bay Area result from severe soil-related limitations on the use of soil absorption systems. The Soil Conservation Service has classified the soils they map into three categories of limitations for soil absorption systems--slight, moderate, and severe (Table 1, below). The vast majority of soils in the Bay Area fall in the severe category (Figure 1, p. 5.). It must be emphasized, however, that these classifications are of degrees of soil limitations. They do not indicate whether or not septic tank systems should be installed in these areas, but rather indicate that special care must be taken when designing, installing and maintaining soil absorption systems.

TABLE 1.

SOIL CONSERVATION SERVICE CRITERIA
FOR SOIL LIMITATIONS FOR SOIL ABSORPTION SYSTEMS*

Assumptions:

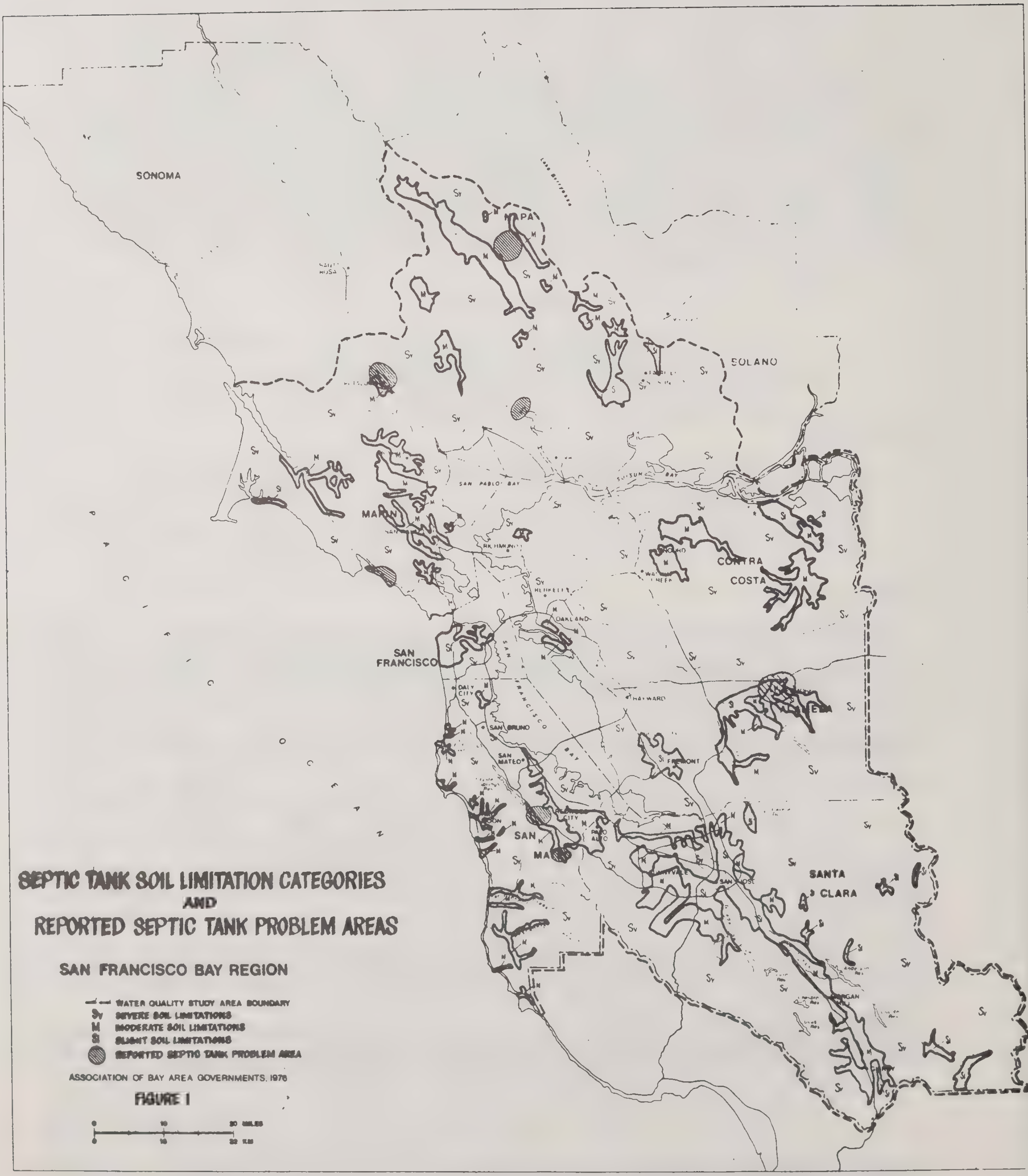
Minimum depth earth cover over lines .... 12 inches
Minimum diameter of lines .... 4 inches
Minimum filter material over lines .... 2 inches
Minimum filter material under lines .... 12 inches

Criteria:

Soil Property or Quality	Degree of Soil Limitation		
	Slight	Moderate	Severe
Permeability (in./hr.)	Greater than 1.0	1.0-0.63	Less than 0.63
Percolation rate (min./in.)	Faster than 45	45-75	Slower than 75
Depth to seasonal water table (ft.)	Greater than 4	2-4	Less than 2
Drainage class	Excessively, somewhat excessively, well*	Moderately well, somewhat poorly	Poorly, very poorly
Depth to impervious bedrock and hardpan, and permanent water table (ft.)	Greater than 6	4-6	Less than 4
Slope (%)	0-5	5-9	Greater than 9
Overflow hazard (frequency in years)	None	1 in 10	1 in 5
Overflow duration (hr.)	None	Less than 48	Greater than 48

*Coarse textured materials may allow contamination of water supplies.

*Source: Soil Conservation Service, 1968, P. a25. If a mixture of conditions occurs, the soil is put in the most severe applicable category.


SONOMA
NAPA
SOLANO
MARIN
SAN PABLO BAY
SUISUN BAY
RICHMOND
BERKELEY
OAKLAND
CONTRA
COSTA
SAN
FRANCISCO
DALY CITY
SAN BRUNO
SAN MATEO
HAYWARD
FREMONT
PALO ALTO
SAN JOSE
SANTA
CLARA
SAN FRANCISCO BAY
SEPTIC TANK SOIL LIMITATION CATEGORIES
AND
REPORTED SEPTIC TANK PROBLEM AREAS
SAN FRANCISCO BAY REGION
WATER QUALITY STUDY AREA BOUNDARY
Sv SEVERE SOIL LIMITATIONS
M MODERATE SOIL LIMITATIONS
Sl SLIGHT SOIL LIMITATIONS
REPORTED SEPTIC TANK PROBLEM AREA
ASSOCIATION OF BAY AREA GOVERNMENTS, 1976
0 10 20 MILES
0 10 20 KM
FIGURE 1

REASONS FOR SYSTEM FAILURES

Septic tank disposal systems can fail in a number of ways. The methods of failure and causative factors are as follows:

1. Inappropriate choice of a waste disposal system. In some cases, a septic tank system is selected as a means of waste disposal under circumstances that will prevent the system from ever working properly. Examples are sites that are small in area, frequently water logged, steeply sloping or underlain by rock. These are generally failures in the leach field system.

2. Improper design and construction. Even when a site is suitable for septic tank use, failure may occur because the system is not designed properly or built to take advantage of the site's natural characteristics. A poorly designed or inadequately sized septic tank will permit an unacceptable amount of solids carry-over into the drain field or will require frequent maintenance cleaning. An improperly sized or constructed drain field will cause too rapid a soil saturation and/or clogging in the disposal area, resulting in wastewater backup, surface ponding, or rapid discharge to a natural water body.

3. Inadequate maintenance. A well-designed and built system on a favorable site will fail if it is not maintained. Maintenance is most frequently applied to the septic tanks and involves removal of accumulated solids and greases. Failure to do this ensures carry-over of this matter into the drain field where it can clog soil pores, decreasing total system capacity and producing effects similar to those from an undersized drain field. A less frequent maintenance chore involves clearing of rotts or soil blockages from the drain field tiles, a difficult chore requiring excavation of the drain tiles.

RESPONSIBILITY FOR SEPTIC TANK SYSTEMS

Principal responsibility for the operation and maintenance of septic tank systems lies with the individual homeowner. If a system becomes a nuisance or health risk the County Health Department can require the homeowner to repair or maintain the system. In extreme cases the Health Department can require that the property be vacated.

Although the Regional Water Quality Control Board are empowered to issue discharge permits they have resolved not to do so. Instead they rely on the County Health Departments to inspect and monitor the performance of septic tank systems. In cases where water quality standards are violated the Regional Board can prohibit the use of septic tanks.

MANAGEMENT PROBLEMS

The management problems associated with the use of septic tank systems fall into several categories:

1. Technical decision-making. The decision as to whether a particular home or group of dwellings is best served by sewers or septic tanks is often made without a full evaluation of all relevant factors and is often unevenly influenced by financial considerations.

2. Lack of information. Good data on which to base technical decision-making is usually lacking. The performance of existing systems is poorly documented as is the cause and effect relationship between septic tank systems and resulting pollution problems.

3. Lack of uniformity in design and construction requirements.

4. Lack of adequate inspection and maintenance.

5. The relationship between waste disposal regulation and land-use control. Retention of septic tank systems rather than installing sewers has sometimes been used as a means of maintaining large lot sizes and associated life styles. <u>This tends to muddy the waters</u> of what should be purely technical decision-making.

Each of these management problems is discussed below.

Technical Decision-making

As noted in the introduction to this memorandum the trend in the last 100 years has been away from the septic tank system. Occasionally the momentum of the trend has been so great that a sewage collection system has been built when a community's needs could better have been served by well-maintained septic tank systems.

Lack of Information

The number and location of failing septic tank systems are difficult to document because such surveys are expensive to conduct and because people are reluctant to allow inspectors into their homes. In addition, surveys to determine whether ground or surface waters are contaminated by septic tank effluents are expensive, due to the need for drilling to collect samples of ground water, and to the need for tests to determine whether coliform bacteria are present and of human origin. Associated health problems are also difficult to document because they are usually related to the increased transmission of disease within a single household, cases of which are rarely reported.

Design and Installation

Most sanitarians agree that the design and installation of septic tank systems are tied to the properties of the soils on which they are placed. This relationship has contributed to the decision of the Regional Water Quality Control Boards to delegate responsibility for regulating the systems to the County Health departments. However, instead of local requirements being responsive to local field conditions, the requirements have become inconsistent and often incomplete.

A review of the guidelines of several organizations for septic tank installation and of the requirements of the eight Bay Area County Environmental Health Divisions regulating septic tank system use is informative.* Several organizations have developed guidelines for septic tank systems, including the U.S. Department of HEW Public Health Service, the International Association of Plumbing and Mechanical Officials, Building Officials and Code Administrators International, Inc., the Southeastern Wisconsin Regional Planning Commission, the University of California, the State Water Resources Control Board, and the Regional Water Quality Control Boards. The suggested requirements of these organizations are tabulated in Appendix B. Similar types of requirements have been tabulated for the various County Health Departments in the Bay Area in Appendix A. The variations in the guidelines are reflected in the variations in the local requirements, which are embodied in County ordinances and codes. The inadequacies of the existing requirements can be traced to an emphasis on numerical standards as opposed to system performance and to a lack of supporting technical findings for most of these guidelines or requirements. The inadequacies are especially apparent in the percolation test, design and setback, and soil analysis requirements.

The current inconsistency of percolation tests makes any comparison of test results meaningless. According to Winneberger and Klock (1973, p. 60):

> It is not generally realized by persons performing percolation tests that the depth of water filling, the size of the percolation test hole, and whether or not gravel is used to support the sides of the hole are critical considerations. A hole filled deeper with water has a faster percolation rate. A shallower and wider hole has a slower percolation rate. A hole backfilled with gravel has a faster percolation rate than the same hole would have had without the gravel.

These conclusions were supported with experimental evidence. Using a power auger as opposed to hand auger to dig the test hole also greatly reduced the percolation rate.

The inconsistent setback and design requirements indicate a lack of supportive experimental evidence. Three examples illustrate this point. First, an emphasis on numerical setbacks tends to ignore the effect of soil characteristics on the soil absorption system configuration required to ensure that there are no unacceptable adverse effects on water quality and health. Second, the design requirements emphasize specific designs. They should emphasize general criteria for the performance of the systems, providing guideline design specifications as well as a means to change that design to fit variable soil conditions. Third, large lot sizes have been used to provide adequate area for future soil absorption systems. A provision for two full-sized fields that could be alternated and for adequate area to replace both systems based upon local conditions, is much sounder than a minimum lot size requirement.

The requirements for soil and geologic analysis, though potentially very useful, are often lacking or inadequate. Soil analysis, in conjunction with percolation tests, has the potential for improving the reliability

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*San Francisco does not allow new septic tank systems.

of soil testing.* A qualified soil expert needs a reasonable soil exposure with which to work. The disturbed contents of a single small diameter hole is not reliable as an indicator of the soil structure in a given area. A trench made from a backhoe is a very helpful tool (Winneberger and Klock, 1973). Soils can be observed in place and the upper boundary of the ground water can be determined. The trench also enables the observer to have a better notion of both the horizontal and the vertical variations of the soil than does a boring. This test enables the most favorable areas and layers to be identified and utilized in designing the system. In spite of the apparent usefulness of a requirement for soil analysis, the current requirements of Bay Area counties range from non-existent, to a single hole 8 feet deep, to a general geologic investigation.

Inspection and Maintenance

In spite of the obvious subjectivity of the tests used for design of septic tank systems and in spite of the empirical basis of the designs, very few provisions have been made for inspection and maintenance of the systems after they have begun operating. Such necessary procedures are assumed to be done by the owner of the system. Although such practices are obviously not a substitute for an adequately designed system, they can be an invaluable tool in making sure that operable soil absorption systems remain operable by providing for periodic pumping of the septic tank and for turning the valve of an alternate system. The most progressive local health departments in this regard in the Bay Area are that of: Alameda County, which provides system owners with a handout with recommendations on how to maintain a system; Solano County, which inspects systems every 5 years unless they are on lots greater than 10 acres; and Marin County, which inspects new systems every two years. Public management agencies with inspection duties have been proposed for Stinson Beach and Portola Valley and an informal district has been set up in Bolinas.

Existing sewerage services agencies have been hampered in their ability to alleviate septic tank problems. These agencies do not have legal powers to inspect private property for septic tank system performance nor do they have powers to perform maintenance activities on those systems. The lack of agency ownership of or control over use of the septic tank systems on private property is a strong disincentive to involvement with such systems. Additionally, domestic systems are not service areas for sewerage agencies.

Septic Tanks and Land Use

The use of septic tank systems has a number of land use implications. Septic tank systems require a certain minimum acreage to work satisfactorily and are consequently associated with low population density and large residential lots. Enforcement of stringent regulations controlling

*The lack of realiability of percolation tests was well illustrated when the results of various experienced percolation rate testers were compared using a standard testing procedure for a 0.2 acre site in Arizona (Winneberger and Klock, 1973, p. 72): "The range was from 2 to 259 min./in. The range just about traversed the spectrum of results available the world over."

minimum lot sizes for septic tank use is tantamount to land use regulation when no alternative waste disposal system exists. Having failed to get local jurisdictions to adopt zoning ordinances that further their aims, some advocates of land-use controls have tried to use septic tank regulations to "back-door" land use regulation.

Issues of this kind tend to confuse decision-making as to the most appropriate waste disposal system for a particular area.

POSSIBLE SOLUTIONS

At least five methods of correcting the inadequacies of existing individual home sewage disposal practices should be examined:

1. Require public management of septic tank systems, including both inspection and maintenance.

2. Revise state and federal grants program guidelines to ensure consideration for funding of individual systems in the evaluation of alternatives.

3. Revise existing requirements for design and construction of septic tank systems.

4. Promote research on how septic tank systems work, on how they can be made to work better, and on what home sewage disposal systems other than septic tank systems could be used in areas where sewers are not economically feasible.

5. Replace septic tank systems with sanitary sewers and treatment systems where septic tank systems are clearly unworkable.

Each of these actions addresses some of the problems examined earlier. None, by itself, can solve all of the problems associated with the use of septic tank systems. In the discussion which follows, each control strategy will be discussed in terms of the issues that it addresses, and how it might be accomplished.

Public Management

Public management of septic tank systems transfers some of the responsibility for effective operation of the systems from the homeowner to the public agency. The responsibilities of the public agency might range from a simple inspection and permitting function to responsibility for approving design and construction, routine maintenance and monitoring of performance.

A management agency could maintain good records of types and locations of septic tanks and leach fields. Routine monitoring will build a data base that can be used to refine and improve design and construction requirements. Because the agency would provide routine maintenance, failures could be attributed to design deficiences which may be correctable. In cases where the homeowner failed to make needed improvements the agency could be vested with the authority to make the improvements and bill the homeowner.

It is not essential that a public agency actually undertake the maintenance of septic tank systems. Maintenance services, and even inspection, may be performed by private firms under contract to the public agency. What is important, is for a pbulic agency to take the responsibility and assure that the proper actions will occur. The responsibile agency can be a new maintenance district or an existing agency such as health departments or sewerage/utility districts.

The California Health and Safety Code, Section 6950, ammended 1977, delineates procedures for the establishment of the responsible agency and the range of duties such an agency would have with respect to existing residences using on-site systems. For new construction, the RWQCB issued on August 19, 1977, a proposed policy on discrete sewerage facilities. This proposal policy requires that a government agency accept responsibility for preventing pollution caused by on-site wastewater disposal and the procedures for the prevention be spelled out before approval is given to construction of any development with six or more homes.

Revise State and Federal Grants Program

An allowance by EPA and the State of California on grant funding of individual or neighborhood systems could provide the needed incentive or economic support to sewerage or septic tank districts to undertake responsibility for this management problem. At this time, septic tank systems serving clusters of homes, and which are built, owned and operated by districts, are grant-eligible for EPA funds.

California State Senator Behr is sponsoring legislation to enable existing districts to do onsite inspection and, if they wish, maintenance. These districts would have authority to control operation of onsite systems by putting levies on property. (This legislation passed in 1977 and is now part of the Health and Safety Code.)

Improved Requirements for Design and Construction

Whatever the scope of the revisions, the aim of the changes should be to emphasize system performance, increase the flexibility of the design guidelines to suit a given site, increase the regional consistency of the local requirements, and increase the completeness of the requirements.

The following suggested changes would achieve these aims:

1. Standardize the percolation test - The test described by Winneberger and Klock (1973) and summarized in Appendix B under "Arizona Engineering Research Center Guidelines" is an excellent start because most of the requirements are based on experimental evidence. Sonoma County plans to use these requirements.

2. Begin requiring soils and geologic analyses to determine whether they could eventually be used to supplement the percolation test. Such an analysis improves the assessment of the depth to seasonal high ground water, improves the selection of those soil layers most suited for absorption systems, and ensures that these systems are not placed on unacceptably unstable ground or on flood plains. Again, the analyses described by Winneberger and Klock (1973) and summarized in Appendix B are a good beginning, as are the analyses required by San Mateo County found in Appendix A.

3. Improve setback requirements - Setback requirements should serve to ensure water quality. The requirements should serve as guidelines that can be changed if the more stringent design and testing requirements are met. They should vary with soil conditions.

4. Change lot size requirements - Sites should be large enough to allow for a pair of alternating fields and later for a replacement pair. The soils in both the initial and reserve fields should all have acceptable characteristics. Large lots are a very inefficient and indirect means of cutting down on nitrate concentrations because of the problems noted in the section on "Rural Land Use Patterns." An upper limit on the number of households served by septic tanks in a given ground water basin (and therefore on the number of unsewered lots) is a much more straight-forward regulation. The proposed RWQCB policy on discrete sewerage facilities would result in the establishment of minimum standards guidelines that could be modified to meet local conditions.

Research

Many of the current requirements for septic tank systems are very arbitrary, largely because not much is known on how septic tank systems, especially soil absorption systems, operate or could be made to operate more effectively. Also, many alternative methods of on-site disposal that might be used in areas where sewers are not economically feasible have not been thoroughly examined.

Research will be encouraged if public management is established. The public agencies will provide both the legitimacy and the field data needed to evaluate changes in requirements. The Rural Waste Disposal Project* should be able to perform much of the research needed on alternative systems.

The value of their research could be greatly augmented by improved documentation of present septic tank system performance by existing agencies. Typically, health departments, which now collect information on health problems due to system failures, might also collect associated engineering and design data, to help provide direct correlation between cause and effect.

Sanitary Sewers

Existing problem areas should be re-examined after they have been publicly maintained to see if further controls are needed (such as mandating community septic tanks or requiring sewers when no other feasible alternative is available).

*The Rural Waste Disposal Project: under the Office of Appropriate Technology, and housed in the State Health Department Building in Berkeley, California.

REFERENCES

California Department of Water Resources, 1974, Hydrologic Data: 1973, Bulletin No. 130-73, Vol. III: Central Coast Area, pp. 85-92.

California Department of Water Resources, 1975, Hydrologic Data: 1974, Bulletin No. 130-74, Vol. III: Central Coast Area, pp. 89-110.

U.S. Department of Commerce, 1970, 1970 Census of Housing Detailed Housing Characteristics - California, U.S. Government Printing Office, Washington, D.C. Table 78.

Winneberger, J.T., and J.W. Klock, 1973, Current and Recommended Practices for Waste Water Disposal Systems in Arizona, Engineering Research Center, College of Engineering Sciences, Arizona State University, Tempe, AZ, 153 pp.

GLOSSARY

ALTERNATING FIELDS - a pair of soil absorption systems connected with a diversion valve so that one field is used for a period (such as a year) and the second field is used for a similar field while the first rests. (Resting allows the fields which would otherwise be exhausted due to clogging.)

EFFLUENT - the outflow of a sewer, septic tank, etc.

GROUNDWATER TABLE - the level below which the voids within the rock and soil are filled with water.

PERCOLATION RATE - the rate at which water drops in a given percolation test (on estimate of permeability).

PERMEABILITY - the soils capability of conducting water (determined by the size and continuity of the soil voids).

SEPTIC TANK - a large underground container in which initial settling and anaerobic treatment of the waste water occurs.

SEPTIC TANK SYSTEM - a septic tank and a soil absorption system used for on-site treatment of waste water.

SOIL ABSORPTION SYSTEM - a leach field, trench system, or pit from which the septic tank effluent moves through the surrounding soil and is filtered and aerobically treated by the soil.

WASTE WATER - sewage

APPENDIX A:

COMPARATIVE SEPTIC TANK SYSTEM REQUIREMENTS IN THE NINE BAY AREA COUNTIES

	ALAMEDA COUNTY	CONTRA COSTA CO.	MARIN COUNTY	NAPA COUNTY	SAN FRANCISCO	SAN MATEO COUNTY	SANTA CLARA CO.	SOLANO COUNTY	SONOMA COUNTY
		being rev.							being rev.
PERCOLATION TEST REQ'S.				HEW manual exceptions		HEW manual		HEW manual exceptions	
Hole width, in inches	at least 12, in dia.	4 to 12	at least 6 in dia.	6, in dia.		1 sq ft, 12, in dia.	-	4 to 12	6 to 8
Digging method	scratch surface	scratch surface	6" auger, scratch surface	dig or bore scratch surface		dig or bore scratch surface	-	dig or bore scratch surface	dig or bore scratch surface
Number of test holes	5/parcel (15'-40' apart)	1/parcel in subdiv., 1+/parcel on bldg.	3/parcel	1/parcel in subdiv., 6/parcel on bldg.		2/parcel	-	3/parcel	3/parcel minimum
Measurement tool	tape to 1/8 rechecked	-	yard stick or equiv.	stick		stick		stick	metal tape
Presoaking time	at least 24 hours continuously	4 hours to night	4 hours to night	4 hours to night		4 hours	-	4 hours to night	day before
Depth of hole	3½ - 5 ft.	to bottom of absorb. device	4 ft., min.	depends on depth of absorb. dev		5 ft., min.		depends on depth of absorb. dev	to bottom of absorb. device
Presoaking water depth	-	-	12 inches	12 inches over gravel minimum		12 inches over gravel minimum	-	12 inches over gravel minimum	36 inches minimum
Water level maintained	6 - 12 in. over gravel	6 inches over gravel	12 inches over gravel	approx. 6 inches over gravel		approx. 10 - 11 inches over gravel	-	approx. 6 inches over gravel	3 - 12 in. over gravel
SOIL PROFILE HOLES									
Number of test holes	at least 1	-	-	at least 1		1/parcel	-	-	at least 1
General requirements	-	mat'l separated & inspected by health dept.	required on discretion of health dept.	-		-	-	-	-
Depth of holes	8 feet	-	8 feet	8 ft., min.		132 inches	-	-	8 ft., min.
Information collected	depth of ground water	-	-	-		depth of hard pan & ground water	-	-	depth of ground water & impervious rock

	ALAMEDA COUNTY	CONTRA COSTA CO.	MARIN COUNTY	NAPA COUNTY	SAN FRANCISCO	SAN MATEO COUNTY	SANTA CLARA CO.	SOLANO COUNTY	SONOMA COUNTY
MINIMUM SETBACK REQ"S.									
Septic tanks to:									
Buildings	10	-	5	5		5	-	0	5
Adjoining property	10	5	5	5(usually)		10	10	10	5
Wells	50	50	100	100		50	-	100-public 50-private	100
Natural water courses	50	50	25	25 (200 if watershed)		20	-	50-lake 50-flowing 25-ephemeral	100-lake 100-flowing 50-ephemeral
Cuts or embankments	-	50	25	5		20	-	10	-
Swimming pools	-	-	10	5		25	-	10	-
Water lines	5	10	10	5		-	-	10	5
Walks and drives	-	5	5	-		can be under occasionally	-	0	-
Foundations	-	10	-	-		5	5	-	-
Large trees	10	10	-	-		-	-	-	10
Other	5- disposal field or pit			5- disposal field				0- easement	5- disposal field & distrib. box
Drainfields to									
Buildings	10	-	10	10		5	-	0	8
Adjoining property	10	5	5	5(usually)		10	10	100	100
Wells	100	50	100	100		75	100(usually)	100	100
Natural water courses	50	50	100	100 (200 if watershed)		20	100(usually)	200-lake 100-flowing 50-ephemeral	100-lake 100-flowing 50-ephemeral
Cuts or embankments	15	50	75	25		20	50(usually)	4xht. of cut	15-fill only
Swimming pools	-	-	25	25		20	-	-	-
Water lines	5	10	10	10		-	-	25	5
Walks and drives	-	5	5	-		0	0	0	-
Foundations	-	10	-	-		5	10	-	-
Large trees	-	10	-	-		-	-	-	10
Other	5-distribution box, 4-disp. field, 5-seep. pit	5-septic tank						0-easement	6-distribution box

	ALAMEDA COUNTY	CONTRA COSTA CO.	MARIN COUNTY	NAPA COUNTY	SAN FRANCISCO	SAN MATEO COUNTY	SANTA CLARA CO.	SOLANO COUNTY	SONOMA COUNTY
DRAINFIELD REQUIREMENTS									
			for absorp. field,since preferred						
Minimum percolation rate, in inches/hour	1.0 (12.0-max.)	1.5 to 2.0 (varies with lot size)	0.5	1.0		0.75	-	1.0	1.0
Trench width or pit dia., in inches	18-minimum 36-maximum	18	-	12-minimum		18-minimum 24-maximum	24-minimum	12-minimum 36-maximum	24-standard
Minimum spacing between trenches, in feet	4 + 2/foot below bottom of drainline	10	-	6 or 2 times depth		2 times the depth	8-level 12-hillside	6	8-typical center to center
Backfill material	rock	stone, slag or gravel	rock	stone, slag or gravel		rock or gravel	rock	rock	rock
Backfill mat'l size, in in	3/4-2 1/2	1-1 1/2	3/4-1 1/2	3/4-1 1/2		3/4- 1 1/2	1½ - 2½	-	3/4-2 1/2
Barrier needed	yes	yes	yes	yes		yes	yes	yes	yes
Soil backfill depth, in in.	12	18	12	12-18		12-18	12-minimum	12-minimum	18-recommend
Min. depth of soil in the drainfield area, in feet	8-below surface	-	4-below surface	3-below trench		3-below trench	-	5-below trench (varies)	1-below trench (varies)
o varies with slope	no	-	no	no		no	-	no	no
Min. depth of ground water in the drainfield area, in feet	8-below surface	4-highest level;below surface	3-highest level; below trench	3-highest level; below trench		3-highest level; below tiles	-	5-mean level below surface (varies)	1-highest level; below trench
o varies with slope	no	no	no	no		no	-	no	usually need drains
Drainfield replacement area required, in % of initial	100	100	100	uses ¼ ac. reserve		100	100	-	200
Description of sidewall area required, if possible	125-330 sq. ft. of bottom area/ bedroom	60-180 linear ft. per bedrm.	600 sq. ft. per capita (or 112 lin. ft./bedrm. if 2'8" deep)	190-600 sq. ft./bedrm.		range from 1960-5040 sq.ft.(3 bedrooms)	decision of health dept.	8000-12000 sq. ft. of usable disposal area	60-165 lin. ft./bedrm. if 3' deep with 12" gravel below pipe
Max. percent slope, in %	25	20	-	-		50	-	25	30

	ALAMEDA COUNTY	CONTRA COSTA CO.	MARIN COUNTY	NAPA COUNTY	SAN FRANCISCO	SAN MATEO COUNTY	SANTA CLARA CO.	SOLANO COUNTY	SONOMA COUNTY
SEPTIC TANK REQUIREMENTS									
Minimum size	1015 gal.	750 gal.	1200 gal.	1200 gal.		1500 gal.	1200 gal.	750 gal.	810 gal.
Depends on bedrooms	yes	yes	yes	yes		yes	-	yes	yes
Material specified	redwood, rein. concrete block or concrete w/ bituminous coat.; fiberglass	not corrosive	concrete or synthetic; no wood	if concrete must have bituminous coating		concrete with bituminous coating	concrete or redwood	water tight and not subject to excessive corrosion	concrete
DISTRIBUTION SYSTEM REQ'S.									
Box required	yes	not specified	-	no		no	no	no	yes
Pipe size to field	4" min. dia.	4" min. dia.	4" min. dia.	-		4" min. dia.	-	-	-
Pipe material to field	vitrified clay, cast iron or plastic	not corrosive	-	-		-	-	-	-
Pipe size in field	4"	4" min. dia.	4" min. dia.	approx.4-5"		4" min. dia.	4" min. dia.	approx.4-5"	3-4" dia.
Pipe placement in field	level, >24" from bottom; > 2" from top	in filter	>2" from top	> 2" from top; >12" from bottom		2" rock above	>12" from bottom; 4" rock above	> 2" from top; > 6" from bottom	> 2" from top
Serial distribution	-	on both slopes and flat areas	on both slopes and flat areas	yes		recommended	typical hillside	recommended	-
Parallel distribution	-	prohibited	prohibited	prohibited		-	typical flat	-	typical
LOT SIZE REQUIRED									
Minimum	40000 sq.ft.	10000 sq.ft.	1 acre	1 acre		varies	varies	5 acres	-
Size dependent on	-	increases to 1 acre if on well	design information and slope <5%=1 acre 5-10%=1.25 10-20%=1.5	<1 acre if to sewer in 5 years; 1-20%=1 ac. 20-50%=1-5 >50%=5 ac.		geology, percolation rate, bldg. location, and available space	-	2 1/2 acres if on public water supply	-

	ALAMEDA COUNTY	CONTRA COSTA CO.	MARIN COUNTY	NAPA COUNTY	SAN FRANCISCO	SAN MATEO COUNTY	SANTA CLARA CO.	SOLANO COUNTY	SONOMA COUNTY
OTHER DESIGN AND CONSTRUCTION REQUIREMENTS	minimum 15' horizontal distance to surface on slopes, no cuts or fills >18", stable material, & uses 1973 UBC	no slides, no 10-year floods field almost flat no hard pan	no springs no fissures no unstable slopes no public hazard dual fields	refers to 1976 UBC		no flooding flat field dual fields requires a geotechnical report on slope stability	-	-	stable slopes abandonment requirements wet weather percolation tests
INSPECTION AND MAINTENANCE	inspected: after installed, after connected	inspected: after excavated after installed (before backfilled)	inspected: after completion & every 2 yrs for systems installed since 1971	inspection depends on systems; varies with the individual lot		inspected: after completed	-	inspected: after completed & every 5 yrs unless lot is larger than 10 ac.	inspected: after construction is completed
CITIES IN COUNTY WITH SEPARATE REQUIREMENTS	Oakland uses 1976 UBC many cities use different min. lot size	none	Tiburon	all		none	Los Altos Hills Morgan Hill Saratoga	Vacaville has its own ordinance with similar requirements	Cloverdale

APPENDIX B:

COMPARATIVE SEPTIC TANK SYSTEM REQUIREMENTS SUGGESTED IN MODEL CODES AND MANUALS

	HEW MANUAL OF SEPTIC TANKS-1967	UNIFORM PLUMBING CODE-1973	UNIFORM PLUMBING CODE-1976	BOCA BASIC PLUMBING CODE-1975	SEWRPC MODEL CODE	ARIZONA ENG RES. CENTER GUIDELINES	SERL REPORT	STATE OF CA WATER RES. CONTROL BD.	REG. WATER QUAL. CON. BD.-REG. 5
PERCOLATION TEST REQ'S.			uses desc. table or test			adj. for gravel			
Hole width, in inches	4-12	Recommends use of desciptive soil table--the specific testing procedure is not specified	-	4-12	-	12 if sq. 14 in dia.	4-12	-	-
Digging method	dig or bore and scratch sides		-	dig or bore with auger and scratch sides	-	dig or bore with hand-tools and scratch side	dig or bore and scratch sides, concrete bottom	-	-
Number of test holes	min. 6 in field area		-	-	6 within field area	3-5 min. per field	6 or more in field	-	-
Measurement tool	fixed ref. (stick)		-	fixed reference	-	float gauge	fixed reference	-	-
Presoaking time	4 hours to night		until thoroughly soaked	4 hours to night	-	overnight if high shrink/swell	4 hours, overnight if much clay	-	-
Depth of hole	depth of proposed trench		-	depth of proposed trench	-	depth or possible depth of trench	depth of possible trench	-	-
Presoaking water depth	12" min. carefully		-	12" min.	-	~8", fill carefully	12" min.	-	-
Water level maintained	approx. 6" above gravel		-	approx. 6" above gravel	-	exactly 6" above gravel	approx. 6" above gravel	-	-
SOIL PROFILE HOLES									
Number of test holes	Cuts, well logs, and excavations useful for information on ground water and the subsurface	-	-	-	2	1 per 2 perc tests	at least 1	-	-
Depth of holes		-	-	-	8 feet	with back-hoe as deep as it can	-	-	-
Information collected		-	-	-	-	bedrock & groundwater depth, gen. soil information	bedrock, gen. soil info., ground water depth (also examine SCSwork veg., climate)	-	-

	HEW MANUAL OF SEPTIC TANKS-1967	UNIFORM PLUMBING CODE-1973	UNIFORM PLUMBING CODE-1976	BOCA BASIC PLUMBING CODE-1975	SEWRPC MODEL CODE	ARIZONA ENG. RES. CENTER GUIDELINES	SERL REPORT	STATE OF CA. WATER RES. CONTROL BD.	REG. WATER QUAL. CON. BD.-REG. 5
MINIMUM SETBACK REQ'S.									
Septic tanks to:									
Buildings	5	5	5	5	10	-	-	-	0
Adjoining property	10	5	5	-	10	-	-	-	25
Wells	50-varies	50	50	-	50	-	-	-	50-100
Natural water courses	50-varies	50	50	-	100	-	-	-	25-50
Cuts or embankments	-	-	-	-	-	-	-	-	10
Swimming pools	-	-	-	-	-	-	-	-	-
Water lines	10-varies	5	5	-	-	-	-	-	-
Walks and drives	-	-	-	-	-	-	-	-	0
Foundations	-	-	-	-	-	-	-	-	-
Large trees	-	10	10	-	-	-	-	-	-
Other	-	5-disposal field	5- disp. field, pit or cesspool	-	-	-	-	-	0-easement
Drainfields to:									
Buildings	20	8	8	10	25	-	-	-	0
Adjoining property	5	5	5-8	10	10	-	-	-	50-75
Wells	100-varies	100	100-150	100 (rarely 50)	50	-	-	-	100-150
Natural water courses	50-varies	50	50 if field 100 if pit or cesspool	-	50	-	-	-	50-200
Cuts or embankments	-	-	15 horz.	-	25	50-varies	-	-	4 x height
Swimming pools	-	-	-	-	-	-	-	-	-
Water lines	25-varies	5	5	-	-	-	-	-	-
Walks and drives	-	-	-	-	-	-	-	-	0
Foundations	-	-	-	-	-	-	-	-	-
Large trees	if within 10', 12" of gravel under tile	-	0 if field 10 if pit or cesspool	-	-	-	-	-	-
Other	-	5-distribution box	4-dist. box 4-12-drainfield	-	-	-	-	-	0-easement

	HEW MANUAL OF SEPTIC TANKS-1967	UNIFORM PLUMBING CODE-1973	UNIFORM PLUMBING CODE-1976	BOCA BASIC PLUMBING CODE - 1975	SEWRPC MODEL CODE	ARIZONA ENG RES. CENTER GUIDELINES	SERL REPORT	STATE OF CA WATER RES. CONTROL BD.	REG. WATER QUAL. CON. BD.-REG. 5
DRAINFIELD REQUIREMENTS									
Minimum percolation rate, in inches/hour	1.0 (gen. 60.0 max.)	1.11 gal/ sq.ft. leach. area	1.11 gal/sq ft leach area/24 hrs	-	shallow=1.0 deep=2.0 & 6.0 max.	1.0	-	-	field=1.0 pit=2.0 max.=12.0
Trench width or pit dia., in inches	-	18-36	18-36	min.=12	-	min.=12	-	-	-
Minimum spacing between trenches, in feet	6 between excavations if serial dist.	6 center to center	4 + 2 times ft. deep in excess of 1	6	-	6 between excavations	it varies (often 6 - 10 center to center)	-	-
Backfill material	-	stone, slag gravel, etc	stone, slag gravel, etc	rock	-	durable	sand&gravel	-	-
Backfill mat'l size, in in	½-2½	3/4-2½	3/4-2½	½-2½	-	(gen.<1"dia 30%+ voids	gradation bottom-top	-	-
Barrier needed	yes	-	yes	yes	-	-	-	-	-
Soil backfill depth, in in	12, if ser.	12=min. 18=pref.	12=min. 18=pref.	-	-	gen. 12=min	-	-	-
Min. depth of soil in the drainfield area, in feet	4-below trench	-	-	-	4-below trench	4-6 below trench if flat	-	10	5 below trench, 10 below pit
o varies with slope	no	-	-	-	no	2.5-3.5 if slope	-	no	no
Min. depth of ground water in the drainfield area, in feet	4 = max. height be-low trench	-	-	-	4 - below trench	4 - below trench	7½ - 15 below trench	10	-
o varies with slope	no	-	-	-	no	no	no	no	-
Drainfield replacement area required, in % of initial	100 usually	100	100	-	-	100	required, no amt. is specified	-	-
Description of sidewall area required, if possible	trench bot-tom area of 70-330 sq. ft. per bedroom	bottom area of 20-90 sq.ft./ 100 gal. of septic tank capacity	relates tank capa-city, soil grain size, and design to side wall + bottom area	165-330 sq. ft.of bot-tom area/ bedroom	-	833 sq. ft. if 1 in/hr to 120 sq. ft. if >60 in/hr	2 acres of surface area per 1 acre-ft. of wastewater	-	6000 to 12000 sq. ft. surface area
Max. percent slope, in %	-	-	-	-	12% if near shoreline	70% if done carefully	-	30%	30%

	HEW MANUAL OF SEPTIC TANKS-1967	UNIFORM PLUMBING CODE-1973	UNIFORM PLUMBING CODE-1976	BOCA BASIC PLUMBING CODE-1975	SEWRPC MODEL CODE	ARIZONA ENG RES. CENTER GUIDELINES	SERL REPORT	STATE OF CA WATER RES. CONTROL BD.	REG. WATER QUAL. CON. BD.-REG. 5
SEPTIC TANK REQUIREMENTS						refers to HEW manual			
Minimum size	750 gal.	750 gal.	750 gal.	750 gal.	1000 gal.		-	-	-
Depends on bedrooms	yes	yes	-	yes	no		-	-	-
Material specified	corrosion resistant and water tight; may be concrete if plaster coated	corrosion resistant; steel and concrete must be coated	corrosion resistant; concrete must be reinforced and protec-ted	corrosion resistant; may be concrete	-	-	-	-	-
DISTRIBUTION SYSTEM REQ'S.									
Box required	no	yes	if >1 line	-	-	no	-	-	-
Pipe size to field	-	-	-	-	-	1¼" or more	-	-	-
Pipe material to field	-	watertight	watertight	-	-	watertight	-	-	-
Pipe size in field	4"	-	-	-	-	as large as pipe to field	-	-	-
Pipe placement in field	>6" from bottom; >2" from top	>12" from bottom; >2" from top	>12" from bottom; >2" from top	>6" from bottom; >2" from top	-	4" min. from top and sides	-	-	-
Serial distribution	-	-	-	-	-	OK on flat or sloping ground	-	-	-
Parallel distribution	-	-	-	-	-	not recom. on slopes	-	-	-
LOT SIZE REQUIRED									
Minimum	-	-	-	-	-	-	-	½ acre	-
Size dependent on	-	-	-	-	-	to allow for system and replacement	-	-	-

APPENDIX B (cont.)

	HEW MANUAL OF SEPTIC TANKS-1967	UNIFORM PLUMBING CODE-1973	UNIFORM PLUMBING CODE-1976	BOCA BASIC PLUMBING CODE-1975	SEWRPC MODEL CODE	ARIZONA ENG RES. CENTER GUIDELINES	SERL REPORT	STATE OF CA WATER RES. CONTROL BD.	REG. WATER QUAL. CON. BD.-REG. 5
OTHER DESIGN AND CONSTRUCTION REQUIREMENTS	recommends soils and geologic information be used in determining min. standards; abandonment standards	abandonment standards	abandonment standards; maximum line gradients; designed to use best soil	alternate designs are subject to review before approval	no flooding ground water $>$ 8' from undisturbed surface same for bedrock	no flooding avoid swales breathers at all ends of fields (aerobic) alternating fields	put sand on hole sides alternate fields aerobic system rapid loading of system sections	-	-
INSPECTION AND MAINTENANCE	inspected: after constructed but before soil backfilled	inspected: after constructed but before soil backfilled	inspected: after constructed but before soil backfilled	-	-	recommends public management	-	-	subdivisions of $>$100 lots or with pot. problems must form a public entity

APPENDIX TABLE C

Septic Tank Problem Areas[a]

COUNTY	PROBLEM AREA	NATURE OF PROBLEM
Alameda	Unidentified lacations within Oakland, Hayward, and Livermore-Amador Valley. Suspected problems in Sunol.	Septic tank malfunctions significant causes of ground-water pollution.
Contra Costa	-- no report as of June, 1977 --	
Marin	No specific areas identified.	Failing septic tanks possible sources of bacteriological contamination.
Napa	Edgerly Island	Limited drain fields for septic tank systems create existing health problems and potential river pollution problem.
	Auction Yard area, Kelley Road	Overburdened systems and impermeable soil strata producing septic tank effluent.
	Angwin	Overburdened and failing systems and thin soil mantle creates septic tank discharge to Conn Creek which may create potential problem to Lake Hennessey.
San Mateo	Emerald Lake Hills	Identified pollution problem from septic tanks; nature of problem not discussed.
	Colma	Existing and potential problems; not specified.
	Palomar Park	Potential problem; not specified.
	Seywood	Potential problem; not specified.
	Cuesta La Honda	Potential problem; not specified.

a. Source: ABAG, Surface Runoff Management Program, County Progress Reports, 1977.

COUNTY	PROBLEM AREA	NATURE OF PROBLEM
San Mateo (continued)	Sky Londa	Potential problems; not specified.
	County Club Estate	potential problem; not specified.
	Woodside Hills	Potential problem from malfunctioning septic tanks.
	Portola Valley	Malfunctioning septic tanks.
	Arrowhead Meadow	Potential problem; not specified.
	Woodside Highland	Potential problem; not specified.
	Los Trancos Woods	Potential problem; not specified.
	Stonegate	Potential problem; not specified.
	Redwood Terrace	Potential problem; not specified.
Santa Clara	Los Altos Hills	Malfunctioning septic tank leach fields; unsure of magnitude of problem.
	Los Gatos	Minor problem with malfunctioning septic tank leach fields on hillsides.
	Between Gilroy and Moraga Hill	Problem of unknown magnitude from malfunctioning septic tank leach fields in rural land development.
Solano	Green Valley Creek and Suisun Creek Area	Problems caused by high water table.
Sonoma	Glen Ellen	Septic tank and leach field malfunctions resulting in water well contamination.
	North of City of Petaluma	Malfunctioning septic systems caused by inadequate soil percolation; leading to water well contamination.

May 20, 1977

TO: Miscellaneous Sources Technical Advisory Committee

FM: Bruce D. Fitting and Terry Bursztynsky Bruce TAB

RE: Implementing Possible Solutions in the Septic Tank Management Plan

ABAG staff has identified two key institutional and financial topics in the septic tank management plan. These topics are as follows:

1. Septic tank maintenance districts

2. Grant-eligibility of septic tanks

The materials below have been prepared on these two subjects. Please review and be prepared to discuss your comments at the Technical Advisory Committee meeting on June 1.

SEPTIC TANK MAINTENANCE DISTRICTS

The maintenance of private on-site wastewater disposal systems, or septic tanks, has until quite recently been considered the sole responsibility of private property owners. Supervision of this process has been exercised by the County Health Departments. It is now recognized that the present legal and administrative situation is not completely satisfactory.

When existing systems begin to malfunction, the Health Department may begin to take action. In extreme cases, the agency is authorized to declare a septic tank system to be a public health nuisance, thereby opening the door for a health-related eviction of the owner or resident. No County Health Department though will take such a drastic step unless absolutely necessary. Furthermore, the Departments have no authority to repair malfunctioning systems or have them repaired. Nor do they have the right to enter private property at all without a court order; owners who deny access to health inspectors force them into a time-consuming process to obtain the necessary court orders. The net result is that the County Health Departments under current legal and administrative practices are hampered in many important ways in solving the problems associated with malfunctioning systems.

If the problem becomes widespread in a community, the Health Department may make an environmental health survey in order to determine the nature and degree of system failure. It then prepares a report based on the survey. The report might be sent to the Regional Water Quality Control Board. The Regional Board will then consider the evidence and may institute a ban on further septic tank systems in the area. The Regional Board may also require replacing septic tanks with sewers. This situation usually leads to the construction of a publicly-owned Federal- and State-subsidized wastewater collection system and treatment plant. Glen Ellen and several other smaller Bay Area communities are examples where this sequence of events has taken place.

Septic tank units are most often found in low-density relatively rural small communities. The construction of sewer systems and treatment plants in these areas has often been criticized as too expensive for its purpose. Both the total cost and the local share of the cost can be high. Even with the maximum 87½ percent contribution by the U.S. Environmental Protection Agency and the State Water Resources Control Board, local residents are yet faced with the remaining 12½ percent of the construction costs, all costs for operating and maintaining the system, and considerable individual expense to connect residences into the system. Furthermore, not all project costs will be eligible for the 87½ percent subsidy; in Glen Ellen, for example, only 40.7 percent of these costs could be subsidized at the 87½ percent level.

The threat of such costs has led some communities -- Stinson Beach, for example--to reject bond issues needed for financing the local share. In these instances, the building ban has continued but so have any health problems associated with the continued reliance on malfunctioning septic tanks.

A need for alternatives to replacing existing septic tanks with conventional collection and treatment systems has clearly been created. Recent discussion has focused on the possibility of public management of privately owned units. The concept is that if septic tanks are technically appropriate for their sites, they can be maintained and kept in a sanitary manner through public management. The result would be that health problems can be solved, any building ban could be lifted, reasonable community growth can take place, and exorbitant costs to property owners will be avoided.

Under current statutory authority, septic tank maintenance responsibilities in California can be assumed by a city, county, or a limited number of special district types--specifically those with wastewater collection and treatment responsibilities such as community services districts, public utility districts, sanitary districts, and so on. A very important limitation appears to exist, however, in that public management of septic tanks can only be established at the time of septic tank installation. In other words, existing units cannot be converted from private to public management in the absence of special State legislation. The vast majority of septic tanks in California are at present privately maintained; therefore, the potential exists for continuing health problems and building bans.

Several jurisdictions throughout the State have initiated public septic tank management for new units. Counties are most frequently involved in this, with such duties usually delegated to a County Service Area. Santa Cruz County, for instance, has enacted an ordinance establishing these responsibilities in County Service Area No. 12, which serves a rural tract of vacation homes. An example of a special district is the Georgetown Divide Public Utility District in the Placerville area, which has formed an Improvement District for this purpose.

The enabling ordinances contain a number of important provisions. Among them is the authorization of on-site inspection of privately owned systems. A court order is not required for access.

Ordinances often, though not always, authorize public maintenance of the units as well. County Service Area No. 12 in Santa Cruz County is allowed to perform routine maintenance as part of its inspection responsibilities. If more serious problems are uncovered during the course of this inspection, the property owner will be billed for services necessary to correct them.

In other districts, the discovery of a malfunction may lead the inspector to order the property owner to correct the problem. Alternatively, the maintenance district may choose to make the necessary repairs and bill the owner. If the bill is not paid, a lien can be placed on the property.

Another key provision is the establishment of regular service charges to property owners for routine inspection and maintenance. This provides a regular and continuing source of operating revenue for the district. Moreover, in the Georgetown Divide Public Utility District, the formation of an Improvement District has allowed the jurisdiction to supplement such user charges with property tax revenues.

In at least one California jurisdiction, public septic tank maintenance responsibilities have been implemented so as to promote residential growth. The Ventura County Department of Environmental Health had adopted septic tank regulations which would prevent growth from taking place in certain hilly sections of the County. One such section receives wastewater service through the Camrosa County Water District. The Ventura County Board of Supervisors, in an attempt to circumvent this barrier to growth, passed an ordinance authorizing Camrosa to review and permit new septic tank installations in its district without the requirement for further approval from the County Department of Environmental Health. Under the ordinance, Camrosa would also be allowed to inspect and maintain the installations. At this time, the situation has not been completely resolved to everyone's satisfaction, particularly that of the health department.

The critical problem in septic tank maintenance, as mentioned above, is that public management is limited to new units. In the case of Stinson Beach, which is served by aging septic tanks, special State legislation was sought and enacted to create public management of the existing systems. To date, this is the only such example.

Legislation to authorize the Stinson Beach County Water District to undertake these responsibilities specifically (Senate Bill 1902) was introduced by Senator Peter Behr and approved on September 13, 1976. The Stinson Beach law goes a bit farther than the comparable county ordinances. The statute empowers the County Water District to inspect and maintain private systems, to enter onto private property for these purposes, to abate any public nuisance caused by improperly discharging septic tanks, and to recover abatement costs from dischargers by civil suit. These charges can become a lien on the property, collectible in the same manner as district taxes. In addition, requirements on septic tank owners are enforced by means of a district wide permit system, with owners being required to optain permits before discharge. Permit fees can be charged to cover any or all septic tank maintenance functions exercised by the district.

New State legislation (Senate Bill 430) has recently been submitted by Senator Behr that would extend the Stinson Beach model to all cities and any special district involved in sewage collection or treatment. Counties could also participate through the creation of a County Service Area for this purpose. Under the proposal, "on-site wastewater disposal zones" could be created within these jurisdictions to manage existing septic tanks. Formation would be through a joint effort of the agency's board of directors,

the Regional Water Quality Control Board, and the county health officer. Duties would include on-site inspection and maintenance as described above. Costs incurred by the zone in abating a violation would be billed with the property taxes, and if left unpaid would constitute a lien on the parcel.

Details of the proposed law are now beginning to emerge. It received the support of ABAG and its Legislation and Governmental Organization Committee on April 28, 1977. It was heard by the Senate Local Government Committee on May 9 and reported out favorably to the full Senate. An aide to Senator Behr expects that no significant opposition to the bill will emerge during the legislative process. If ratified, the proposed law will approve on a broad scale the public management of existing privately owned septic tank systems and thereby remove legislative and administrative barriers for this purpose. (This legislation is now part of the Health and Safety Code, Section 6950.)

GRANT-ELIGIBILITY OF SEPTIC TANKS

Individual privately-owned septic tank systems are not eligible for grant subsidies from either the Environmental Protection Agency or the State Water Resources Control Board. Virtually all septic tanks now operating, under construction or proposed in California are privately owned. Federal and State grant regulations require that grant-eligibility be conditioned on public ownership and maintenance, and for all intents and purposes this does not exist in California. As a result, the 75 percent Federal subsidy and the 12½ percent State subsidy for constructing wastewater treatment systems do not apply to septic tanks.

In the usual analysis of wastewater project alternatives preparatory to construction, central systems will be favored over septic tanks. Although a central system will typically involve higher overall construction costs, the local share will be less because of the Federal and State grants. All other things being equal, therefore, local wastewater engineers and planners are most likely to select the central system. If Federal and State regulations were amended to make privately owned individual systems grant-eligible on an equal basis, it is certain that they would be selected more frequently.

The federal attitude on funding the construction of septic tanks appears to be changing. EPA recently issued a policy directive on February 1, 1977 indicating that publicly owned septic tanks serving two or more parcels and small package treatment plants are grant-eligible. Until the Federal agency reverses its position on the requirement for public ownership, however, little will change in California. EPA may revise its regulations in the near future, with one possibility being that individual privately owned but publicly managed systems will be eligible. It appears, though, that some form of Congressional direction will be required before interpretations more favorable to septic tanks can be rendered.

Despite the absence of Federal and State grant monies for septic tank installation, public septic tank maintenance functions are eligible for these subsidies. A wastewater treatment Step 1 grant can be used to prepare a project report recommending public septic tank maintenance. Furthermore, pumper trucks, sludge treatment facilities and other capital equipment used in public operation and maintenance are eligible for Step 3 grants. Only the privately owned septic tank systems themselves would not be fundable under current EPA and State regulations.

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Peter Y. Chiu

WATER QUALITY MANAGEMENT PLANS

EXISTING AND PLANNED WASTEWATER MANAGEMENT

FACILITIES IN THE SAN FRANCISCO BAY REGION

TECHNICAL MEMORANDUM No. 5
June 13, 1977

The existing and planned wastewater management facilities (201 facilities) in the San Francisco Bay region are summarized in the following two tables.

Most of the information was obtained from the project reports and environmental impact documents for the facilities. Other information sources include telephone contacts and interviews with the responsible local agencies and their consultants, as well as the staff of the Regional Water Quality Control Boards.

It should be noted that only facilities within the 208 planning bounderies are listed in the summary. Comments, corrections, or additions are requested.

TABLE I. EXISTING MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

1. ALAMEDA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD, pounds per day (year)	Influent TSS, pounds per day (year)	Effluent dis-charged to
East Bay Municipal Utility Dist. Special Dist. No. 1	EBMUD primary plant and interceptors	Alameda, Albany, Berkeley, Emeryville, Oakland, Piedmont, Stege S.D.	625,000 (75)	52,800 (75)				93 (75)		254 (75)	254,000	186,000	S.F. Bay
City of San Leandro	San Leandro secondary plant	San Leandro	41,100 (75)	4,700 (70)	11.0		24.0	6.7 (75)	9.6 (75)	22.0 (75)	14,500 (75)	14,000 (75)	S.F. Bay
City of Hayward	Hayward secondary plant	Hayward	93,900 (75)	15,000 (70)	19		32	11.3 (75)	16.5 (75)	31.0 (75)	17,000 (75)	18,400 (75)	S.F. Bay
Oro Loma Sanitary Dist.	Oro Loma S.D. secondary plant	Oro Loma S.D.	142,000 (75)	17,800 (70)	20		85	13.3 (75)	19.3 (75)	68.0 (75)	28,800 (75)	36,200 (75)	S.F. Bay
Union Sanitary Dist.	Union S.D. Alvarado secondary plant	Union S.D.		6,700 (70)	4		8	3.5 (75)	6.0 (75)	9.5 (75)	8,500 (75)	7,900 (75)	Alameda Creek
Union Sanitary Dist.	Union S.D. Newark secondary plant	Union S.D.		10,500 (70)	7			6.2 (75)	9.8 (75)	14.0 (75)	15,300 (75)	11,600 (75)	Newark Slough
Union Sanitary Dist.	Union S.D. Irvington	Union S.D.		10,000 (70)	9			6.1 (75)	10.0 (75)	13.8 (75)	12,700 (75)	11,400 (75)	Mud Slough
City of Livermore	Livermore secondary plant	Livermore	49,164 (75)	8,300 (70)	5.0			4.0 (74)	8.3 (74)	9.8 (74)			Arroyo Los Positas
Valley Community Services Dist.	VCSD secondary plant	VCSD	42,316 (75)	9,910 (70)	4.0			4.1 (74)		11.8 (74)			Alamo Canal
City of Pleasanton	Pleasanton secondary plant	Pleasanton	16,575 (75)	4,600 (70)	1.7			1.3 (74)	2.6 (74)	4.0 (74)			

TABLE I. EXISTING MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

2. CONTRA COSTA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD pounds per day (year)	Influent TSS, pounds per day (year)	Effluent discharged to
Richmond	Richmond M.S.D. No. 1 secondary plant (activated sludge)	Richmond	58,500 (73)	18,000 (70)	10.7		39.0	5.4 (73)		39.0 (73)			S.F. Bay
San Pablo Sanitary Dist.	San Pablo S.D. secondary plant (activated sludge)	San Pablo, Tara Hills, parts of Richmond, El Sobrante, Pinole	70 000 (73)	17,800 (70)	12.5		42.0	5.9 (73)		19.0 (73)			San Pablo Bay
City of Pinole	Pinole secondary plant (activated sludge)	Pinole, Hercules	14,000 (73)	10,300 (70)	2.0			1.3 (73)		3.7 (73)			San Pablo Bay
Rodeo Sanitary Dist.	Rodeo S.D. secondary plant (activated sludge)	Rodeo, Oleum	5,750 (73)	7,600 (70)	1.14		4.5	0.7 (73)		1.1 (73)			San Pablo Bay
Crockett-Valona Sanitary Dist.	Crockett-Valona primary primary plant	Crockett, Valona	3,600 (73)	1,200 (70)	0.55		1.0	0.25		2.2			Carquinez Strait
Mountain View Sanitary Dist.	Moutain View S.D. secondary plant (trickling filter)	Martinez (part of)	11,000 (70)	3,800 (70)									Peyton Slough
Central Contra Costa Sanitary Dist.	Centra Contra Costa S.D. primary plant	Orinda, Moraga, Lafayette, Walnut Creek, Martinez, Pleasant Hill, Danville, San Ramon, Concord	286,000 (76)	62,000 (70)	30 (76)	48 (76)	140 (76)	29.2 (75)			54,000 (76)	60,000 (76)	Suisun Bay
City of Concord	Concord secondary plant	Concord, Clayton	68,000 (76)	22,000 (70)	5		15	4.8 (73)					
Port Costa Sanitary Dist. (C.C.C.S.D. No.5)	Port Costa septic tank system	Port Costa	300 (70)	30 (70)									Carquinez Strait
C.C.C.S.D. Nos. 7A & 7B	Shore Acres primary plant	Shore Acres, Nichols, Shell Tract	10,900 (75)	3,800 (70)	1.6			0.92 (75)					Suisun Bay
City of Pittsburg	Pittsburg, Montezuma primary plant	Pittsburg (part of)	18,240 (75)		2.0			2.49			792 (75)	400 (75)	Sacto. River
City of Pittsburg	Pittsburg Camp Stoneman primary plant	Pittsburg (part of)	5,660 (75)		4.6			0.56 (75)			542 (75)	383 (75)	New York Slough
City of Antioch	Antioch primary plant	Antioch	33,500 (75)	5,440 (70)	2.6			2.6			1550 (75)	867 (75)	San Joaquin River
City of Brentwood	Brentwood secondary plant (trickling filter)	Brentwood	3,570 (75)	400 (70)	1.0			0.41 (75)					land irrigation
Oakley Sanitary District	Oakley S.D. septic tank system	Oakley	1,950 (75)	300 (70)	0.15			0.15 (75)					Delta at Big Break
C.C.C.S.D. No. 15	Bethel Island individual septic tank systems	Bethel Island	1,700 (75)										Delta
C.C.C.S.D. No. 19	Discovery Bay aerated pond	Discovery Bay	80 (75)		0.1			0.014 (75)					Delta
Byron Sanitary District	Byron biological plant	Byron	260 (75)		0.1			0.03 (75)					Indian Slough

TABLE I. EXISTING MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

3. MARIN COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD, pounds per day (year)	Influent TSS, pounds per day (year)	Effluent discharged to
Marin C.S.D. No. 5	Marin C.S.D. primary plant	Tiburon, Belvedere	5,557 (70)	1,910 (70)	1.4		7.5	0.66 (75)					Raccoon Strait
Richardson Bay S.D.	Richardson Bay S.D. secondary plant (activated sludge)	Richardson Bay S.D.	2,600 (70)	650 (70)	0.32		1.28	0.15 (75)					Richardson Bay
Cities of Sausalito-Marin City	Sausalito-Marin City primary plant	Sausalito, Marin City, Tamalpais Valley	19,200 (70)	3,820 (70)	2.0		8.0	1.74 (75)					S.F. Bay
City of Mill Valley	Mill Valley secondary plant (trickling filter)	Mill Valley, Homestead Valley S.D., Almonte S.D., Kay Park Sewer Main. Dist., Alto S.D.	16,805 (70)	5,145 (70)	1.6		7.4	1.63 (75)					Richardson Bay
Marin C.S.D. No. 1	Marin C.S.D. No. secondary plant (trickling filter)	Ross Valley, Corte Madera, Larkspur	60,000 (70)	18,610 (70)	4.5		16.0	4.56 (75)					Corte Madera Creek
San Rafael S.D.	San Rafael S.D. secondary plant (activated sludge)	San Rafael	27,000 (70)	6,310 (70)	5.0		16.0	3.83 (75)					San Rafael Bay
San Rafael S.D.	San Rafael S.D. Marin Bay secondary plant (trickling filter)	Marin Bay	1,500 (70)	3,200 (70)	0.2			0.08 (75)					San Pablo Bay
Las Gallinas Valley S.D.	Las Gallinas Valley S.D. secondary plant (trickling filter)	Las Gallinas	24,700	12,800 (70)	2.25		12.6	2.00 (75)					San Pablo Bay
Novato Sanitary Dist.	Novato S.D. main secondary plant (activated sludge	Novato			3.0		23.0	2.47 (75)					San Pablo Bay
Novato Sanitary Dist.	Novato S.D. Ignacio secondary plant (trickling filter	Ignacio			1.2		6.5	1.16 (75)					San Pablo Bay
Novato Sanitary Dist.	Novato S.D. Bahia secondary plant (activated sludge)	Bahia			0.2		1.2	0.03 (75)					Petaluma River
Tomales Sewer Maintenance Dist.	Tomales individual septic tanks and sewers	Tomales											
North Main County Water Dist.	Point Reyes Station individual septic tanks	Point Reyes											land irrigation
Bolinas Community Public Utility Dist.	Bolinas Community P.V.D. secondary plant (oxidation ponds)	Bolinas downtown areas											land irrigation
Stinson Beach County Water Dist.	Stinson Beach individual septic tanks	Stinson Beach											land disposal

TABLE I. EXISTING MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

4. NAPA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD, pounds per day (year)	Influent TSS, pounds per day (year)	Effluent discharged to
Napa Sanitation Dist.	Napa S.D. secondary plant (oxidation ponds)	Napa S.D.	58,000 (77)	4,100 (70)	8			5.2 (76)			8,130 (76)	9,900 (76)	Napa River
American Canyon Water Dist.	American Canyon CWD secondary plant (oxidation ponds)	American Canyon C.W.D.	5,000 (77)	590 (70)	0.52			0.55 (72)					Slough to Napa River
City of Yountville	Yountville secondary plant	Yountville		350 (70)	0.125		0.43	0.15 (75)		0.95 (75)			Napa River
State Veterans Home	Veterans Home secondary plant	Veterans Home in Yountville					2.0	0.35 (75)		1.80 (75)			Napa River irrigation
City of Helena	St. Helena secondary plant (oxidation ponds)	St. Helena	3,808 (76)	1,300 (70)	0.5			0.25 (76)					Napa River, land irrigation
City of Calistoga	Calistoga advanced treatment plant (coagulation & filtration)	Calistoga	3,000 (76)	1,800 (70)	0.4	0.8	2.0	0.27 (76)	0.38				Napa River, land irrigation

5. SAN FRANCISCO COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD, pounds per day (year)	Influent TSS, pounds per day (year)	Effluent discharged to
City & County of S.F.	S.F. North Point primary plant	San Francisco	354,000 (70)	9,300 (70)	65			62.6 (73)	83.9 (73)				S.F. Bay
City & County of S.F.	S.F. Southeast primary plant	San Francisco guadalupe Valley Muni. Improvement Dist.	166,300 (70)	8,800 (70)	19			22.0 (73)	32.1 (73)				S.F. Bay
City & County of S.F.	S.F. Richmond - Sunset primary plant	San Francisco	220,000 (70)	10,400 (70)	21			21.8 (73)	34.0 (73)				Pacific Ocean
City & County of S.F.	S.F. McQueen wastewater reclamation plant				1			0.8					land irrigation

6. SAN MATEO COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD, pounds per day (year)	Influent TSS, pounds per day (year)	Effluent dis- charged to
Cities of San Carlos - Belmont	San Carlos - Belmont joint secondary plant	Cities of San Carlos and Belmont	51,600 (70)	7,400 (70)				5.3 (74)	7.7 (74)	14.0 (74)	15,800 (74)	10,100 (74)	S.F. Bay
City of Redwood City	Redwood City secondary plant	Redwood City, Fair Oaks Sewer Maintenance Dist.	73,900 (70)	11,000 (70)				8.2 (74)	12.0 (74)		24,800 (74)	13,800 (74)	S.F. Bay
Menlo Park Sanitary Dist.	Menlo Park S.D. primary plant	Parts of Atherton, Redwood City, Woodside, Portola Valley, Menlo Park	45,500 (70)	8,000 (70)				5.5 (74)	8.0 (74)	13.5 (74)	8,900 (74)	11,900 (74)	West Point to S.F. Bay
City of San Mateo	San Mateo primary plant	City of San Mateo, Hillsborough (part of), Crystal Springs C.S.D.	88,100 (73)	9,600 (70)	13.0		30.0	10.5 (73)	17.0 (73)	12.3 (73)	18,500 (73)	17,600 (73)	S.F. Bay
Estero Muni. Improvement Dist.	Estero M.I.D. primary plant	Foster City	18,300 (73)	2,600 (70)	3.8		10.0	1.7 (73)	3.4 (73)	3.6 (73)	2,310 (73)	3,500 (73)	S.F. Bay
Cities of South San Francisco - San Bruno	South S.F. - San Bruno secondary plant	South S.F., San Bruno	87,092 (75)	11,600 (70)	13.0		35.0	8.7 (75)			19,600 (75)	18,000 (75)	S.F. Bay
City of Burlingame	Burlingame secondary plant	Burlingame Hillsborough (part of)	33,176 (75)	6,000 (70)	4.7	7.0	16.0	4.8 (75)			14,600 (75)	14,500 (75)	S.F. Bay
City of Millbrae	Millbrae secondary plant	Millbrae	20,670 (75)	2,080 (70)	3.0	4.5	9.0	2.4 (75)			5,000 (75)	5,000 (75)	S.F. Bay
San Francisco Airport	S.F. Airport secondary plant	S.F. Airport	17,400,000 (75)	2,500 (70)				0.9			2,300 (75)	5,000 (75)	S.F. Bay
North San Mateo County Sanitation Dist.	North San Mateo C.S.D. primary plant	Parts of Daly City, Colma, San Francisco, South S.F., Westborough County Water Dist.	67,600 (73)	7,600 (70)	4.0			4.2			9,935 (73)	9,935 (73)	Pacific Ocean
City of Pacifica	Pacifica primary plant	Pacifica	39,000 (76)	8,000 (70)	6.0			3.0 (76)					Pacific Ocean
Montara Sanitary	Montara S.D. secondary plant	Montara S.D.	2,910 (73)	810 (70)	0.5		1.0	0.2 (73)	0.8 (73)	1.3 (73)	233 (73)	291 (73)	Pacific Ocean
Granada Sanitary Dist	Granada S.D. primary plant	Granada S.D. (El Granada, Princeton)	3,036 (73)	2,200 (70)	0.3		1.0	0.2 (73)	0.4 (73)	0.8 (73)	425 (73)	395 (73)	Pacific Ocean
City of Half Moon Bay	Half Moon Bay secondary plant	Half Moon Bay	4,917 (73)	5,100 (70)	1.0		3.5	0.3 (73)	0.5 (73)	1.8 (73)	541 (73)	344 (73)	Pacific Ocean

TABLE I. EXISTING MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

7. SANTA CLARA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD, pounds per day (year)	Influent TSS, pounds per day (year)	Effluent discharged to
City of	Palo Alto secondary plant	Palo Alto, Los Altos, Los Altos Hills, Mountain View, East Palo Alto S.D., Stanford U., Barron Park, Moffet Field, Las Encinas S.D.	187,000 (76)	37,500 (70)	35	50	70	23.04 (76)					South S.F. Bay
City of Sunnyvale	Sunnyvale secondary plant	Sunnyvale	105,900 (76)	11,770 (70)	16.0	22.5	35.0	16.5 (76)					South S.F. Bay
Cities of San Jose/ Santa Clara	San Jose/Santa Clara secondary plant	San Jose, Santa Clara, S.D. Nos. 2,3 & 4, Campbell, Los Gatos, Monte Sereno, Burbank, Cupertino, Sunol, Saratoga and Milpitas Sanitation Districts	817,000 (76)		160		340	86 (76)					South S.F. Bay
Cities of Gilroy-Morgan Hill	Gilroy-Morgan Hill joint primary plant	Gilroy, Morgan Hill	24,315 (76)		1.81		4.6	2.5 (76)		10.6 (76)	4,500 (76)	5,000 (76)	land disposal

8. SOLANO COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD, pounds per day (year)	Influent TSS, pounds per day (year)	Effluent discharged to
City of Benicia	Benicia primary plant	Benicia	10,500 (73)	5,985 (70)	3.0		6.0	0.95		6.0	2,542	2,792	Carquinez Strait
Fairfield-Suisun S.D.	Fairfield-Suisun subregional tertiary plant	Fairfield-Suisun S.D., Cities of Fairfield and Suisun, Cordelia, Green Valley (and Travis Air Force Base in the near future)		2,811 (70)	10.35		16.2	6.2 (76)					Boynton Slough, irri-
Vallejo S.D. & FCD		Vallejo		16,600 (70)	7.0		28.0						Carquinez Strait

9. SONOMA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Population served (year)	Service area, acres (year)	Design capacity, mgd: Average dry weather flow	Design capacity, mgd: Peak dry weather flow	Design capacity, mgd: Peak wet weather flow	Existing flow, mgd (year): Average dry weather flow	Existing flow, mgd (year): Peak dry weather flow	Existing flow, mgd (year): Peak wet weather flow	Influent BOD, pounds per day (year)	Influent TSS, pounds per day (year)	Effluent discharged to
City of Petaluma	Petaluma secondary plant (oxidation ponds)	Petaluma	32,000 (76)	75,120 (70)	5.2			3.0 (76)	(76)	6.0			Petaluma River
Sonoma Valley County S.D.	Sonoma Valley C.S.D. secondary plant	Sonoma, Schellville, El Verano, Boyes Hot Springs, Aqua Caliente, Glen Ellen	19,000 (74)	108,800 (70)	2.0			1.9 (74)		5.32 (74)			Schell Slough to San Pablo Bay

TABLE II. PLANNED MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

1. ALAMEDA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
East Bay Municipal Utility Dist. Special Dist. No. 1	EBMUD plant expansion and upgrading to secondary	Alameda, Albany, Berkeley, Emeryville, Oakland, Piedmont, Stege S.D.	650,000 (95)	120	168	330	63	Done	Done	Done	6/77
East Bay Municipal Utility Dist. Special Dist. No. 1	EBMUD solids processing facilities						18	Done	Done	7/76	7/78
East Bay Municipal Utility Dist. Special Dist. No. 1	EBMUD wet weather facilities						51.4	3/78	1/79	3/79	3/81
East Bay Municipal Utility Dist. Special Dist. No. 1	EBMUD wastewater reclamation facilities						50	4/78	79-80	80-81	
East Bay Dischargers	EBDA transport and outfall facilities	San Leandro, Oro Loma S.D., Castro Valley S.D., Hayward Union S.D.	562,200 (95)	56.7	84.3	175.9	75	9/77	9/78	12/78	8/80
East Bay Dischargers	Oro Loma plant we weather facilities to meet secondary treatment standards; Hayward plant and San Leandro plant improvements to meet S.S. requirement						27	77-78	77-78	78-79	
East Bay Dischargers	Union S.D. Alvarado plant improvements						33			77-78	
East Bay Dischargers	Union S.D. plant expansion and possible upgrading						10.8				
East Bay Dischargers	EBDA reclamation-reuse study								77-78		
City of San Leandro	San Leandro wastewater reclamation facilities	San Leandro					0.8	77-78	78-79	78-79	
City of Livermore	Livermore plant expansion by 1 mgd for wastewater reclamation project	Livermore					5.7	77-78	77-78	77-78	
Valley Community Services Dist.	VCSD plant expansion to consolidate with Pleasanton	VCSD, Pleasanton					12	Done	7/77	10/77	6/79
City of Pleasanton	Pleasanton transport facilities to VCSD for treatment						5	Done	7/77	10/77	6/79
Livermore-Amador Valley Water Management Agency	LAVWMA transport facilities to EBDA outfall for treated wastewater disposal	City of Livermore City of Pleasanton	150,958 (98)		18.62	19.72	28	Done	7/77	12/77	6/79

TABLE II. PLANNED MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

2. CONTRA COSTA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
Richmond Municipal Sewer Dist. No. 1											
San Pablo Sanitary Dist.	San Pablo S.D. secondary plant improvements	San Pablo, Tara Hills, parts of Richmond, El Sobrante, Pinole	124,309 (86)	11.7		25.0(s) 37.5(p)					
San Pablo Sanitary Dist.	San Pablo S.D. wastewater reclamation facilities							77-78	77-78	77-78	
Rodeo Sanitary Dist.	Rodeo S.D. deep-water outfall	Rodeo, Oleum	11,500 (86)	1.3		3.6(s) 3.2(p)					
Crockett-Valona Sanitary Dist.	Crockett-Valona S.D. and C & H Sugar joint secondary plant	Crockett-Valona S.D., C&H Sugar	3,900 (85)	0.3 plus 1.48 for C&H		1.2 plus 1.48 for C&H		77(C-V)	77(C-V)	77(C-V) Done(C&H)	78(C-V) 77(C&H)
West Contra Costa County Agencies	WCCC Agencies extended outfall and transport facilities for joint disposal of treated wastewater from Richmond M.S.D. No. 1, San Pablo S.D.										
Mountain View Sanitary Dist.	Mountain View S.D. plant dechlorination facilities						0.28		77-78	77-78	
Port Costa Sanitary Dist. (C.C.C.S.D. No. 5)	Port Costa secondary treatment facilities						0.23		77-78	77-78	
Central Contra Costa Sanitary Dist.	C.C.C.S.D. plant improvement & wastewater reclamation						70	Done	Done	Done	1/77
Centra Contra Costa Sanitary Dist.	C.C.C.S.D. secondary plan expansion	Orinda, Moraga, Lafayette, Walnut Creek, Martinez, Pleasant Hill, Danville, San Ramon, Concord		40.072			13.5	3/77	3/78	7/78	7/80
Central Contra Costa Sanitary Dist.	C.C.C.S.D. solids disposal and energy recovery facilities						19	6/77	3/78	7/78	7/80
Central Contra Costa Sanitary Dist.	C.C.C.S.D. transport facilities to eliminate Bollinger Canyon beach line discharge						0.6			7/78	
Central Contra Costa Sanitary Dist.	C.C.C.S.D. secondary plant expansion and upgrading to advanced treatment						48	82-83	84-85	85-86	
City of Concord	Concord transport facilities to C.C.C.S.D. secondary plant for treatment	Concord, Clayton	188,000 (92)	19		41					
East/Central Contra Costa County Agencies	Camp Stoneman subregional secondary plant or Shore Acres subregional secondary plant	Shore Acres, Pittsburg, Antioch	(86)	9.48							
East/Central Contra Costa	Oakley S.D. plant improvements; transport facilities from Bethel Island (C.C.C.S.D. No. 15) to Oakley for wastewater treatment	Oakley S.D., Bethel Island									

TABLE II. PLANNED MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

3. MARIN COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
East Marin subregional system agencies	East Marin treatment transport and disposal facilities	East Marin County					75	6/78	7/79	11/79	6/81
North Marin County Water	Tomales treatment and disposal facilities	Tomales	500 (86)	0.038		0.240		Done	Done		
North Marin County Water Dist.	Point Reyes Station treatment and disposal facilities	Point Reyes Station	732 (97)	0.056		0.196		Done			
Stinson Beach County Water Dist.	Stinson Beach collection, treatment and disposal facilities	Stinson Beach									
Marin Municipal Water Dist., Marin C.S.D. No. 1	Lower Ross Valley reclamation facilities						0.28			77-78	
City of Mill Valley	Mill Valley reclamation facilities						0.25			77-78	
Las Gallinas Valley S.D., Marin Municipal Water Dist.	La Gallinas reclamation facilities						0.49			77-78	

TABLE II. PLANNED MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

4. NAPA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
Napa Sanitation Dist., American Canyon County Water Dist.	Napa S.D. and American Canyon C.W.D. joint advanced treatment plant; transport facilities from American Canyon to Napa for advanced treatment	Napa S.D., American Canyon C.W.D.	94,000 (85)	9.0		15.4	17	Done	Done	Done	1/78
Napa Sanitation Dist., American Canyon County Water Dist., Valljo Sanitation & F.C.D.	N.S.D., A.C.C.W.D., V.S. & F.C.D. wastewater solids management facilities	N.S.D., A.C.C.W.D., V.S. & F.C.D.					38			77-78	
City of Yountville	Yountville-State Veterans Home joint secondary plant and seperate disposal facilities	Yountville, State Veterans Home	3,200 (90)	0.5		2.0	3	Done	6/77	10/77	4/79
City of St. Helena	St. Helena secondary plant improvements	St. Helena					1	5/77	12/77	4/78	4/79
City of Calistoga	Calistoga reclaimed wastewater transport facilities	Calistoga					1	Done	12/77	4/77	4/78
Napa County	Edgerly Island collection, treatment and disposal facilities	Edgerly Island						77-78	77-78	78-79	
Napa Sanitation Dist., Carneros Water Dist.	Carneros reclamation facilities	Carneros					4.5	77-78	78-79	79-80	

5. SAN FRANCISCO COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
City & County of S.F.	Southeast plant improvements	San Francisco					8.9	Done	7/77	2/78	11/80
	Southeast plant wet weather solids handling expansion						62.3	78/79	80-81	82-83	
	Southwest primary-secondary plant						75-65	7/77	7/79	1/80	12/82
	Southwest wet weather primary plant						116.87	7/77	7/79	1/80	12/82
	North Shore outfall consolidation						51.5	Done	Done	77-78	
	Ocean outfall (Phase II)						88.0	Done		77-78	
	Channel pump station and wet weather force main						13.35	81-82	83-84	84-85	
	Richmond tunnel (Phase II)						38.6	77-78	79-80	80-81	
	Fulton/Lincoln, Seacliff, & Vicente storage basins (Phase II)						26.7	80-81	81-82	82-83	
City & County of S.F.	Lake Merced area storage/transport (Phase IV)	San Francisco					26.9	81-82	80-81	83-84	84-85
	Crosstown tunnel and and wet weather force main: Southwest plant to southwest force main junction at 14th St. (Phase I)						71.2	79-80	80-81	81-82	
	Crosstown tunnel and wet weather force main: 14th St. to Eddy & Polk (Phase II)						17.8	82-83	84-85	85-86	

TABLE II. PLANNED MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

6. SAN MATEO COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
South Bayside System Authority (SBSA)	SBSA subregional secondary plant at Redwood Shores; transport facilities from Menlo Park S.D. to Redwood City and San Carlos - Belmont plants	Belmont, San Carlos, Redwood Shores, Fair Oaks Sewer Maintenance Dist., Menlo Park S.D.	200,400 (85)	24	36	68	41	Done	6/77	10/78	4/80
San Mateo County	Emerald Lakes Hills collection system	Emerald Lakes Hills					5.3	77-78	77-78	78-79	
City of San Mateo	San Mateo-Foster City joint secondary plant; transport facilities from Estero Municipal Improvement Dist. (Foster City) to San Mateo	San Mateo, Hillsborough (part of), Crystal Springs C.S.D., Foster City	120,300 (85)	14.2	23.3	37.0	20	Done	Done	11-76	11-78
City of San Mateo	San Mateo wastewater reclamation facilities	San Mateo					0.6		77-78	77-78	
Cities of South S.F.-San Bruno	South S.F.-San Bruno joint secondary improvements	South S.F., San					1.8			77-78	
City of Burlingame	Burlingame secondary plant improvements	Burlingame, Hillsborough (part of), Burlingame Hills Sewer Maintenance Dist.	42,000 (2000)	4.7	7.0	16.0		Done	Done		
City of Burlingame	Burlingame wastewater reclamation facilities	Burlingame						77-78			
City of Millbrae	Millbrae secondary plant improvements	Millbrae	27,000 (2000)	3.0	4.5	9.0		Done	Done		
North Bayside System Unit	South S.F.-San Bruno, Burlingame, Millbrae, S.F. Airport wastewater solids manage, facilities						5.4	Done		77-78	
North San Mateo County Sanitation Dist.	N.S.M.C.S.D. plant upgrading to secondary	Parts of Daly City, Colma, S.F., South S.F., Westborough County Water Dist.	84,900 (2000)	8.0		12.0	16	Done	Done	Done	8/77
City of Pacifica	Pacifica plant upgrading to secondary	Pacifica	39,500 (85)	4.3				Done	Done	Done	7/78
City of Pacifica	Pacifica infiltration/inflow study and sewer repairs	Pacifica					1.8	77-78	77-78	78-79	
Sewer Authority Midcoastside	Half Moon Bay, Montara S.D., & Granada S.D. joint secondary plant and outfall; transport facilities from Montara and Granada to Half Moon Bay	Half Moon Bay, Montara S.D., Granada S.D.		2.0			7	Done	8/77	12/77	1/79

TABLE II. PLANNED MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

7. SANTA CLARA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
South Bayside Dischargers Authority	SBDA subregional transport facilities and outfall for joint disposal of treated wastewater	San Jose/Santa Clara Palo Alto, Sunnyvale					80		77-78	78-79	
Cities of San Jose/Santa Clara	San Jose/Santa Clara advanced treatment facilities	San Jose, Santa Clara, Cupertino, Saratoga, Campbell, Los Gatos, Monte Sereno, Milpitas	1,035,000 (85)	112	143		65	Done	Done	Done	10/78
Cities of San Jose/Santa Clara	San Jose/Santa Clara solids handling facilities						22			77-78	
City of Santa Clara	Santa Clara northside pump station and force main enlargement	Santa Clara					1.2	77-78	77-78	78-79	
City of Palo Alto	Palo Alto advanced treatment facilities	Palo Alto, Stanford U., East Palo Alto S.D., Los Encinas S.D., Los Altos Hills, Mountain View	196,200 (87)	30.6	39.6	50.6	10	Done	Done	8/77	1/79
City of Palo Alto	Palo Alto plant computer control and solids handling facilities						4			77-78	
City of Sunnyvale	Sunnyvale advanced treatment facilities	Sunnyvale	139,200 (95)				15	Done	Done	Done	1/78
City of Sunnyvale	Sunnyvale						4.3	79-80	80-81	81-82	
City of Palo	Palo Alto advanced treatment facilities for groundwater injection (salt water intrusion barrier)			4.0			4.6	Done	Done	Done	8/77
Cities of Gilroy/Morgan Hill	Gilroy-Morgan Hill joint secondary plant and transport facilities from Morgan Hill to Gilroy for wastewater treatment	Gilroy, Morgan Hill	62,000 (88)	6.4		18.6					
Santa Clara Valley Water Dist.	Joint wastewater reclamation facilities with Milpitas S.D. (using Milpitas plant)						1.4			77-78	
Santa Clara Valley Water Dist.	South Bay salt water intrusion barrier evaluation							80-81			

TABLE II. PLANNED MUNICIPAL WASTEWATER MANAGEMENT FACILITIES

8. SOLANO COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
City of Benicia	Benicia secondary plant	Benicia	18,000 (86)	2.00	4.09	10.4		12/76	8/77	9/77	1/79
Fairfield-Suisun S.D.	Fairfield-Suisun subregional tertiary plant expansion	Fairfield-Suisun S.D., Cities of Fairfield and Suisun, Cordelia, Green Valley, Travis Air Force Base					9	77-78	78-79	79-80	
Vallejo S.D. & F.C.D.	Vallejo S.D. & secondary plant	Vallejo, Mare Island		12.5 (90)				Done	Done	Done	1/77
Solano Irrigation Dist.	Conveyance facilities to transport treated wastewater from Sacramento Regional C.S.D. to Solano County for agricultural use	Solano County					95				

9. SONOMA COUNTY

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
City of Petaluma	Petaluma secondary plant improvements (depending on results of South Sonoma/East Marin Subregional System study)	Petaluma									
Sonoma Valley County Sanitation Dist.	Sonoma Valley CSD secondary plant improvements and expansion; outfall to Sonoma Creek and equalization ponds to insure dilution; effluent distribution and storage facilities for irrigation; wet weather relief facilities	Sono[illegible], Sch[illegible]ville, El [illegible]ano, Bo[illegible] Hot Sp[illegible]s, Aqua Ca[illegible]te, Glen E[illegible]	26,875 (91)	3.0	5.7	21.0	14.5	Done	10/77	2/78	2/80
Sonoma County	Glen Ellen collection sewers	Glen Ellen (County Service Area No. 18)	1,246 (96)	0.13	0.65	0.75		Done	Done		
Sonoma County	Penngrove collection sewers and transport facilities from Penngrove to Petaluma for wastewater treatment	Penngrove (County Service Area No. 19)	2,200 (2000)			0.432		Done	Done		
Sonoma County	Collection system for Petaluma Blvd., [illegible]rth, Bailey Ave., Go[illegible]ge Ave., Jessie L[illegible] and Skillman Lane						1.5	77-78	77-78	78-79	

10. REGIONWIDE & MISC.

Responsible agencies	Description of facilities	Cities and places served	Design population (year)	Design capacity, million gallons per day: Average dry weather flow	Peak dry weather flow	Peak wet weather flow	Est. const. costs, million dollars	SCHEDULE: Complete planning	Complete design	Start construction	Complete construction
East Bay Municipal Utility Dist.	Regional Wastewater solids handling & disposal study and management facilities							12/78			
To be determined	Regional wastewater reuse and reclamation facilities										
California State Dept. of Parks and Recreation	Angel Island State Park interceptor and land disposal facilities						0.75		77-78	77-78	

WQ/Tech Memo 6/May 1977

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WATER QUALITY MANAGEMENT PLANS

VESSEL WASTES - THE PROBLEM AND POSSIBLE SOLUTIONS

TECHNICAL MEMORANDUM NO. 6

May 1977

Revised December 1977

The Plight of the Modern Mariner

Twas summer, Nineteen Seventy.
Assisted by the bank,
Our ship complied with Michigan's rules
And got a holding tank.

Vacation time came in July
We scraped and caulked the hull.
And loaded up our duffle--but
The holding tank was full.

"Oh deck boy can you pump us out?
Our tank is full, we fear."
"You're welcome to our rest rooms
But we cannot pump you here.

We're waiting for our pumps to come;
But for your consolation,
Just ten miles south, the State has built
A brand new pumping station.

So start your cruise without a qualm.
They're there to help you out."
And off we went with minds at ease
A short delay, no doubt.

"Oh station tender, can you help?"
"Yes! Come in August--late.
I've got two thousand boats to serve;
You're nineteen forty-eight."

We took our chances and went on
With stops at every pier.
We came to dread that fearsome cry;
"You cannot pump out here!"

Vacation's end was drawing near.
Our hearts were growing faint.
Oh Water! Water! everywhere
And not a drop to taint.

Now falling leaves pollute the bay,
And hot drinks fill the cup;
But joy is in our ship again.
Our number just came up.

Source: Journal Water Pollution Control Federation, 43, No. 3 p. 453.

INTRODUCTION

The Federal Water Pollution Control Act Amendments of 1972 call for the development of management plans to deal with non-point sources of water pollution. Vessels wastes fall into this category because they may enter the Bay over widespread areas, and are usually not collected in sewers or treated by municipal facilities. The purpose of this technical memorandum is to examine vessel discharges as a non-point source of pollution in the San Francisco Bay region.

Vessel wastes can produce water quality degradation, as measured by coliform organisms, although other pollutants are also discharged. These effects are most evident in enclosed bays and marinas.

Private vessels and U.S. Navy ships are the largest sources of vessel wastes within the San Francisco Bay system. No problems have been documented for commercial craft. U.S. Navy ships are under a modernization schedule to have all ships equipped with holding tanks or on-board treatment systems by 1981.

Private vessels with fixed toilet facilities are subject to Federal regulations requiring on-board treatment systems or holding tanks for new vessels by 1977 and all vessels by 1980. These regulations are being implemented very slowly because:

- Enforcement activities are almost non-existent.
- There is controversy over the appropriateness for the Bay Area of currently approved devices.
- Matching shoreside pumpout facilities are totally inadequate.
- There is an overlap of responsible agencies that is confusing to the boat owner.

California Department of Health prohibitions against dumping of raw sewage at docks or in marinas are not enforced due to funding and manpower shortages.

THE PROBLEM

NATURE OF VESSEL DISCHARGES

Vessel wastes include sewage from on-board sinks, showers and toilets, and bilge wastes, which are waters that drain through a ship and collect in the lowest part of the hull. These waste discharges can adversely affect the following water quality parameters: coliform bacteria, settleable matter, suspended material, color, odor, floatables, biostimulatory substances, dissolved oxygen, and toxicity. The "Water Quality Control Plan Report" for the San Francisco Bay Basin indicates that sewage discharges from vessels have been the cause of localized water quality problems (SWRCB, 1974).

VESSEL POPULATION

The boats and ships in the San Francisco Bay Area have been divided into three categories: pleasure craft, including houseboats; commercial vessels, including fishing boats; and U.S. Navy vessels.

Private Vessels

The number of private pleasure craft registered with the Department of Motor Vehicles in the nin county San Francisco Bay region is 11,287. 137 harbors and marinas were located in the Bay Area with berthing space for a total of 15,186 vessels.

Commercial and Foreign Vessels

In 1975, there were 4,425 commercial vessels, of all flags, entering the Bay (Corps of Engineers, 1975). Of these, 2,377 were domestic and 2,048 foreign. Passenger or dry cargo vessels numbered 2,865; and there were 1,179 tankers and 381 towing vessels. Table 1 lists all commercial vessel traffic for specific areas in the Bay in 1975.

TABLE 1

U.C. Commercial Navigation in San Francisco Bay, 1975

Harbor or Port	Vessels using Facility, number
Port of San Francisco	7,563
Port of Redwood City	280
Port of Oakland	7,762
Port of Richmond	6,130
San Pablo Bay and Mare Island Strait	5,425
Carquinez Strait	6,015
Suisun Bay Channel	2,630

Source: (Corps of Engineers, 1975)

U.S. Navy Vessels

United States Navy docking facilities are located at Alameda, Port Chicago, Mare Island, Oakland, and Treasure Island. There are 34 ships homeported at these complexes, and there is an average of 27 Navy vessels docked at these ports at any single moment. Approximately 11,800 crew members can occupy these vessels, however only about 3,900 stay on board while these vessels are at port.

VESSEL DISCHARGES

Private Vessels

The majority of vessels using the Bay are equipped with toilets. Most private pleasure craft have a flow-through system which flushes wastes directly to the Bay. Federal regulations call for treatment of wastes on board before discharge or, a holding tank to be emptied by marina pumpout facilities.

Most private vessels do not have these facilities. The Federal regulations currently apply to new boats only. For those boats with holding tanks, there is a strong disincentive for their use. For 137 identified marinas in the Bay Area, there are only 12 operating sewage pumpout facilities. This lack of facilities discourages boat owners from installing holding tank type devices. Appendix A lists the names of the identified existing boating facilities, the number of vessels berthed at each, and the availability of a pumpout station. Table 2 summarizes the information in Appendix A.

The other options, on-board treatment devices, may be installed on new vessels but need not to be installed on existing vessels until 1980. The devices are categorized by effectiveness in achieving effluent coliform and floatables levels. Such devices are inherently more complex than simple holding tanks, require the use of chlorine for disinfection and are more expensive to install.

Shoreside facilities for pumping private vessel bilges do not exist. These wastes are discharged to the Bay directly, often within the confines of a harbor or marina.

TABLE 2

Summary of Existing Boating and Pumpout Facilities, March, 1977

County	Berths, number	Registered[b] Boats, number	Pumpout Facilities, number: Currently Operating	Pumpout Facilities, number: Future (F) or Not Operating(NO)[a]
Alameda	4,494	23,204	6	0
Contra Costa	4,594	21,177	2	1(F)
Marin	2,786	6,467	0	1(NO)
Napa	136	3,507	0	0
San Francisco	1,003	4,983	2	0
San Mateo	1,246	12,030	1	1(F)
Santa Clara	246	26,564	0	0
Solano	633	7,268	0	1(NO)
Sonoma	48	6,087	1	0
TOTAL	15,186	111,287	12	4

[a]Source: (ABAG , 1977)

[b]Source: (DMV, State Office, Boat Registration as of March 31, 1977, Mrs. Bennett, Manager, June 1977)

Commercial and Foreign Vessels

Port officials report no problems with large commercial or passenger vessel sewage wastes in the Bay (Port Directors, 1977). This is assumed because these vessels are in port a short time, their on-board crew compliment is very low, and sewage holding tanks can be dumped in the open ocean. The San Francisco Bay Regional Water Quality Control Board (RWQCB) does not have records of sewage pollution from these vessels.

Problems of bilge waste disposal are infrequent. Commercial vessels pump out bilge wastes on the open ocean. When oily bilge wastes happen to be dumped in the Bay, this is treated as a spill and is addressed in the management plan on oil and chemical spills.

U.S. Navy Vessels

Naval vessel are not always able to dump their wastes into the open ocean. They are usually in port long enough to generate substantial quantities of sewage and bilge wastes. Sewage effluent is usally discharged directly to the Bay from Naval vessels in port. The Navy is undertaking a program to redesign vessels to prevent this. As vessels are drydocked for overall maintenance, they are being equipped with holding tanks or onboard treatment facilities. Three vessels homeported in San Francisco Bay are now equipped and have been certified by the Navy to operate installed collection holding and transfer type marine sanitation devices. By 1981, most vessels will have a holding tank system or other marine sanitation device systems. The vessel conversion scheduling is being matched with shore pumpout facility construction. Pier side pumpout facilities are completed at the Alameda station. A facility is currently under construction at Mare Island. This facility and pumpout facilities at Port Chicago and at the Supply Center in Oakland are scheduled for completion by 1981. A facility has not been scheduled for construction at Treasure Island.

If a pumping facility is not available at port, bilge wastes are discharged in one of two ways. Tanker trucks hook-up to the vessels from shore and wastes are pumped directly into their tanks. The trucks then haul the wastes to Class I disposal sites. The Navy also uses "doughnuts" to discard wastes from its vessels. A "doughnut" is a twenty-foot deep oval shaped shell with an open bottom and a floatation ring around it. Bilge wastes are pumped into the doughnut. Detention time is sufficiently long for oily wastes to float to the top of the shell where they are pumped from the water to tanker trucks or a shoreside facility. New doughnuts are being constructed with closed bottoms to prevent escape of oily wastes from accidental overfilling.

PROBLEM AREAS

It is difficult to examine the specific contributions vessel discharges make to water quality. Vessel created pollutants enter the Bay over widespread areas and confirmation of their exact effects on water quality is generally not possible. Visible pollutants, such as litter and oily bilge wastes, can be easily recognized and are usually found within the confines of a marina or harbor. Non-visible pollutants can be identified only by water quality measurements for specific pollutants.

In order to place the following discussion of pollution problems into perspective, an explanation of contamination criteria is in order.

First, coliform organisms are representative of sewage pollution and are relatively easy to identify. Thus bacterial pollution, as measured by coliform numbers, has been used as a simple indication of domestic sewage pollution in receiving waters.

Second, the following criteria for salt and tidal water contact recreation provides a guideline for assessing the significance of bacterial pollution.

> "Samples of water from each sampling station at a public beach or public water-contact sports area shall have a most probable number of coliform organisms less than 1,000 per 100 ml; provided that not more than 20% of the samples at any sampling station, in any 30 day period, may exceed 1,000 per 100 ml., and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 1,000 per 100 ml."

The San Francisco Bay System

The Bay as a whole has not been monitored for indications of vessel originated pollution. Bacteriological investigations of the San Francisco Bay system were conducted in 1962-64, 1973, and 1976. (SERL, 1964; Hallett, 1974; RWQCB, 1976). Table 3 shows a summary of the results of these surveys. Significant improvements had occured in the bacteriological quality of Bay water in recent years. Vessels were not implicated as significant sources of pollution in these studies.

TABLE 3

Summary of Bacteriological Quality From
1962-64, 1973 and 1976 San Francisco Bay Surveys

	Total Coliform, (Fecal Coliform in parenthesis)				
	Central and Lower San Francisco Bay[a]	North San Francisco and San Pablo Bays	Suisun Bay and Carquinez Straits	San Francisco and San Pablo Bays Shoreline	Suisun Bay and river shoreline
1976 median,[b] MPN/100 ml	8 (4)	6 (4)	94 (28)	-	-
1976 samples[b] with MPN 1,000/100ml, percent	100%	100%	80%		
1973 median,[c] MPN/100 ml	10 (3)	30 (2.3)	1,550 (2.3)	116 (28)	470 (36)
1973 samples[c] with MPN 1,000/100 ml, percent	95.6%	97.8%	38.2%	84.6%	70.5%
1962-64 median, MPN/100 ml.	809	785	2,665	-	-
1962-64 samples with MPN 1,000/100 ml (estimated), percent	54	59	17	-	-

a) 1976 survey included lower and South Bays
b) Based on 1 survey
c) Based on 3 surveys

source: (RWQCB, 1976)

An analysis of the relative significance of private vessel wastes upon San Francisco Bay from open water discharges can be made. The following calculations are purely hypothetical and assume a "worst case" situation. They are based upon biochemical oxygen demand (BOD_5) of sewage, a parameter which varies less than do coliform organisms.

- o There are approximately 15,186 pleasure craft berthed in the area. If every single vessel was out on the Bay on one day, and if every craft contained two people, then the maximum raw wastes from these craft would be equivalent to the untreated sewage discharge from a residential community of 33,000 persons or the treated sewage discharge from a residential community of 220,000 persons.

- o This compares to an estimated 1980 treated municipal sewage discharge from 4.7 million persons in the Bay Area. (ABAG, 1977)

- o The maximum pleasure craft waste discharge would be very roughly equivalent to five percent of the 1980 municipal discharge.

It may thus be seen that, in the most extreme case, the open Bay private vessel discharge, while violating the EPA regulations expalined later, would be very minor in comparison to municipal loadings, and resulting effects on the open Bay almost inmeasurable.

Localized Problems

Two studies examined localized beneficial water uses and pollution problems. One near Albany Hill, Point Isabel, and Brooks Island examined shellfish quality (State Department of Public Health, 1970), and the other in Corte Madera Creek and San Rafael Bay looked at both shellfish harvesting and water-contact sports (Bureau of Sanitary Engineering, 1969). Wastewater, including sewage from boats, was implicated as the source of water and shellfish contamination.

The San Francisco Bay Regional Water Quality Control Board conducted a limited investigation of vessel waste discharges in 1973 (RWQCB, 1973). The following areas were surveyed for total and fecal coliforms:

1) Napa River (Mare Island Strait and Vallejo Marina)

2) Richardson Bay

3) Berkeley Marina and Aquatic Park

4) Coyote Point Marina

5) Redwood Creek and local marinas.

The summary results of that survey are shown in Table 4. Many samples showed a total coliform count greater than 1000/100 ml. In Richardson Bay, high coliform concentrations were found in the houseboat area and the Sausalito Municipal Marina. Houseboats have since been connected to a municipal sewer.

The Redwood City area exhibited high coliform counts in Redwood Creek and connecting marinas. While private vessels undoubtedly contributed to the bacterial pollution, undetermined sources on upper Redwood Creek possibly discharged more bacterial organisms.

TABLE 4

Summary of San Francisco Bay Area Marinas Coliform Survey, 1973

Receiving water	Organisms/100ml								
	Ebb Tide						Flood Tide		
	Total Coliform			Fecal Coliform			Total Coliform		
	Max	Min	Median	Max	Min	Median	Max	Min	Median
REDWOOD CITY AREA									
Redwood Creek-Main Channel, June 2	2,400	45	230				24,000	60	2,400
Redwood City Municipal Marina, June 2	620[a]	45	145				620	45	45
Pete's Harbor,									
June 2	2,400	45	425				2,400	45	60
June 25	2,300	4.5	15	620	4.5	4.5			
Redwood Marina,									
June 2	24,000	620	7,000				230	45	60
June 25	230	6	62	62	4.5	6			
Redwood Creek above Redwood Marina, June 25	400,000	23	4,250	2,300	13	425			
WEST BAY									
Coyote Point Marina, June 2	1,300	45	45				230	45	45
NAPA RIVER, June 3, Mare Island Strait	7,000	45	500						
Vallejo Municipal Marina	2,400	60	230						
EAST BAY, June 10									
Berkeley Marina	2,400	45	60				620	45	60
Berkeley Aquatic Park[b]	7,000	45	45						
RICHARDSON BAY, June 28, Mill Valley Channel	62	62	62	62	62	62			
House-boat area	7,000	62	620	2,400	62	500			
Bay waters east of House-boat area	62	13	23	23	4.5	23			
Sausalito Clipper Harbor	230	6	62	230	4.5	23			
Unknown Marina	62	4.5	38	62	4.5	15			
Sausalito Municipal Marina	2,400	6	62	230	4.5	18			

a) Discharge pipe in corner of Marina - 2,400/100ml
b) non-tidal, limited boating activity

Coyote Point Marina, Mare Island Strait and the Vallejo Municipal Marina all produced some samples with high coliform levels. The Berkeley Marina and Berkeley Aquatic Park also exhibited bacterial pollution. However, Berkeley Aquatic Park is a landlocked lagoon with a buried pipe connecting it to the Bay. Boating activities at the park are limited to water ski competition and very small sailboats. It is probable that sources other than vessel wastes account for the coliform levels.

Table 4 shows a substantial variation between maximum, median and minimum coliform levels for any receiving water. This is, to some extent, typical of coliform testing, but also can indicate slugs or patches of polluted water that have not been fully diluted in the receiving water. This could be indicative of intermittent sewage discharges such as toilet flushing from individual boats. Median coliform levels are more representative of the "after dilution" effects of descrete discharges. With the exception of Redwood Marina and Redwood Creek, median values did not exceed 1,000/100ml.

Potential Problems

EPA requirements for on-board vessel waste treatment systems include an effluent coliform bacterial count of 1,000/100 ml, and for some vessels, 200/100 ml. Many of the proposed treatment systems would consist of grinders (or macerators) and chlorinators for the effluent. In order to achieve a high coliform kill in the vessel treatment system, high chlorine dosages may be required; on the order of 20, 40 or 50 mg/l. Yet chlorine residuals of 0.02 mg/l could produce a measureable impact on beneficial marine plankton. (Krock and Mason)

It is possible that in the confines of a marina or harbor, as a result of high use of flow-through marine sanitation devices, there may be an accumulation of residual chlorine sufficient to adversely affect marine organisms. Should any such devices be mis-adjusted, large slugs of chlorine could be dumped into confined areas. Formaldehyde is now appearing as an alternative disinfectant, yet is potentially as dangerous.

This problem may manifest itself in 1977 when new vessels must have a marine sanitation device and increase in 1980 when older vessels must be similarly equipped.

STATUS OF REGULATIONS

Section 101 of the Federal Water Pollution Control Act of 1972 (FWPCA) states a national goal to eliminate discharge of pollutants into United States waters by 1985. Section 312 prevents discharge of untreated or inadequately treated vessel sewage into or upon United States waters.

The goals stated above can be accomplished through use of marine sanitation devices (MSD's) which meet Environmental Protection Agency (EPA) discharge standards. The Coast Guard Marine Sanitation Device Regulations implement EPA discharge standards.

As of April 12, 1976, EPA standards are:

United States Coast Guard certified MSD's on vessels must be designed and operated to prevent overboard discharge of treated or untreated sewage or any waste derived from sewage in the following waters: freshwater lakes, freshwater reservoirs or other freshwater impoundments with inlets or outlets which prevent the ingress or egress of interstate vessel traffic. The use of flow-through treatment devices which are secured so as to prevent discharges in such waters is allowed. A Coast Guard certified MSD permitting discharges is allowable on coastal waters, estuaries, and interconnected waterways, freshwater lakes and impoundments accessible by locks, and other flowing waters which are navigable by interstate vessels.

A State may preempt the Federal marine sanitation device standards and enforce a no discharge requirement for waters requiring greater environmental protection if the EPA Administrator determines that adequate pumpout facilities and treatment systems for vessel sewage are available upon such waters. Section 312(f)(3) of the Federal Water Pollution Control Act details the mechanisms for a state to obtain a no-discharge standard. Section 312(f)(4) says that certain sensitive waters such as marinas, drinking water intakes, water contact recreation areas, and shellfish beds may be declared no-discharge waters by EPA even though adequate pumpout facilities may not exist in such area.

EPA discharge standards are classified as requiring Type I, II, and/or III devices. The manufacturer of marine sanitation devices must specify device Type and advise the consumer of EPA specified no-discharge areas. Table 5 summarizes the vessel operator requirements under the latest EPA standards promulgated on April 12, 1976 pursuant to Section 312 of the FWPCA, as amended.

TABLE 5

EPA MARINE SANITATION DEVICE REQUIREMENTS

Vessel type	Must be equipped with a -[a]	Unless equipped with -
Existing-a vessel whose construction was initiated before Jan. 30, 1975.	Coast Guard certified Type I, II or Type III MSD after Jan. 30, 1980.	On or before Jan. 30, 1978, with any USCG certified flow-through device, which may be used for its operable life. A USCG certified Type I device installed after Jan. 30, 1978, must be replaced by Jan. 31, 1980, with a USCG certified Type II or Type III device.
New-a vessel whose construction was initiated on or after Jan. 30, 1975.	Coast Guard certified Type I, Type II, or Type III MSD on and after Jan. 20, 1977. Coast Guard certified Type II or Type III MSD after Jan. 30, 1980.	A Coast Guard certified Type I MSD installed on or before Jan. 30, 1980, which may be used for the operable life of the device.

Source: Federal Register, 41, No. 71, 12 April 1976, p. 15324.

aAll no-discharge devices (Type III) installed on vessels before January 30, 1975 are already considered certified.

The MSD type requirements are summarized as follows:

- Type I marine sanitation device - under EPA test requirements this device produces an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids. (This includes all flow-through devices certified before the April 12, 1976 ammendments described here.)

- Type II marine sanitation device - under EPA test requirements the effluent must have a fecal coliform count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter.

- Type III marine sanitation device - this device prevents the overboard discharge of treated or untreated sewage or any waste derived from sewage. It is used solely for the storage of sewage and flushwater at ambient air pressure and temperature.

The MSD requirements as promulgated by EPA can only be enforced by a federal enforcement agency, the United States Coast Guard (USCG). If a state has MSD standards stricter than those federally mandated, it is the responsibility of the USCG after January 30, 1980. Until 1980, existing vessels, those whose construction was begun before January 30, 1975, could be the responsibility of the state or a designated local agency such as the RWQCB. The major problem is the lack of funding for any enforcement program. At a meeting on January 20, 1977 the USCG said they will have a minimal enforcement program due to lack of funding. The Coast Guard will board a vessel only "on cause" for some reason other than inspection of the vessel's MSD. If the MSD is found not in compliance with EPA or state standards it will issue a warning the first time. If the vessel is cited a second time for not being in compliance with MSD standards, the vessel operator will receive a fine.

The USCG feels the enforcement responsibility should be shared with the California Department of Navigation and Ocean Development (DNOD). A memorandum of agreement regarding enforcement was to have been reached in February of this year between DNOD and USCG. As of March 1st no agreement has been reached and such an agreement appears to be far into the future.

STATE

State Water Resources Control Board

The State of California has EPA approval to issue waste discharge requirements under Division 7 of the California Water Code. The regulation of water quality is done by the SWRCB and nine Regional Water Quality Control Boards. The SWRCB is the State Water Pollution Control Agency for all purposes of the FWPCA and it formulates state policy for water quality control. All regional boards and all other state agencies must adhere to these policies.

The SWRCB is responsible for making the application to EPA for any vessel waste no-discharge declaration. The application must include the following for each area:

1. Certification that the waters described in the petition require more protection than would be provided by the Federal standards;

2. Evidence that vessel discharge may violate water quality standards in the defined waters and a description of the appropriate water quality standards.

3. A description of the location of pumpout facilities within the proposed no-discharge waters;

4. The schedule of operating hours of the pumpout facilities;

5. The draught requirements on vessels that may be excluded because of water depths adjacent to pumpout facilities;

6. Information ensuring that the treatment of wastes from pumpout facilities is in conformance with Federal law;

7. Information on vessel population and vessel usage on the described waters; and

8. A request from the RWQCB to the SWRCB to submit a no-discharge application to EPA.

The California Assembly passed Assembly Bill No. 2581 as Chapter 6 of Division 3 of the Harbors and Navigation Code, effective 19 September 1974. Section 775 declares that no state or local agency can place any restrictions on marine sanitation devices and that adequate onshore pumpout facilities are necessary for conformance to MSD requirements of the FWPCA. Section 776 says that by 19 September 1977 marine terminals, as required by the SWRCB, shall provide pumpout facilities. The SWRCB is in the process of designating the locations and standards for construction, operation, and maintenance of pumpout facilities. On 18 May 1976 the SWRCB proposed Standards for the Removal of Sewage from Vessels as Subchapter 20, Chapter 3, Title 23 of the California Administrative Code. A public hearing will be held before the proposed regulations are adopted. These regulations are presented in Appendix B.

San Francisco Bay Regional Water Quality Control Board

The RWQCB issued policy statement 70-65 pertaining to vessel wastes on 27 August 1970. The statement says that vessel wastes contribute to the pollution of the San Francisco Bay. It recommends that marine terminal owners install pumpout facilities and vessel owners install holding tanks with adequate hoses for connecting to pumpout facilities. It also asks that the State Board request from the appropriate federal agency a declaration prohibiting vessel waste discharges in the Bay. No direct actions have occurred as a result of the RWQCB's statement.

It is the responsibility of the RWQCB to provide the State Board with the information necessary for application to EPA to have the Bay waters declared no-discharge waters. The RWQCB is currently studying the vessel waste pollution problem and will soon decide if it will again request the State Board to apply to EPA for a no-discharge regulation for the San Francisco Bay.

The RWQCB is responsible for the formulation, adoption and implementation of the water quality control plan for the Bay Area. The November 1974 Water Quality Control Plan Report for the San Francisco Bay Basin designates water quality objectives to ensure the reasonable protection of beneficial uses. Vessel waste pollution has an effect on the following beneficial uses:

1) Water Contact Recreation

   The National Technical Advisory Committee (NTAC) lists surface water criteria for recreational uses. The Committee feels that detectable health effects may occur at a fecal coliform level of about 400 per 100 milliliters.

2) Non-Contact Water Recreation

3) Ocean Fishing and Sport Fishing

4) Aquatic Life Habitats

If the previously mentioned State Board's proposed standards for pumpout facilities are adopted the RWQCB will be responsible for approval of the design and utilization of such facilities in the Bay Area. According to Sections 2824 and 2829 of the State Board's proposed Standards, the RWQCB must inspect and approve the operating and maintenance instructions for completeness and inspect the entire pumpout system annually.

California State Department of Public Health

The Health Department ordered a stop to the discharge of raw sewage into San Francisco Bay in 1945. This was one of the first major steps in controlling pollution of the Bay. It was not until 1968 that vessel pollution was specifically addressed by the Health Department.

The California State Health and Safety Code, Section 4425, prohibits vessels with toilets from operating on lakes, reservoirs, or freshwater impoundments unless the toilets are the no-discharge type so that no human excreta can be discharged into such waters. Section 4431 says the discharge of sewage to navigable waters of the state from a vessel moored to a dock or within the confines of a marina or yacht harbor is a misdemeanor. However, the code does not apply to rivers, estuaries or bays beyond the confines of harbor, dock or marina. The code permits any city, county or district to regulate vessel pollution through stricter provisions than currently found in this health and safety Code.

REGIONAL

San Francisco Bay Conservation and Development Commission (BCDC)

The BCDC was created by the State in 1965 on two main principles:

- o further filling of the Bay should be for only public ports, water-oriented industries, and public recreation; not residential or commercial uses: and,

- o the Bay should be considered as one physical-ecological system.

The BCDC does not deal with water quality control extensively. The Commission's areas of emphasis are shoreline development as it relates to ports, dredging, industries, recreation, airports, housing, and wildlife refuges.

The BCDC's policy as stated in its San Francisco Bay Plan clearly addresses point source pollution:

"The Water quality laws and practices should insure that no project is built within the watershed of the San Francisco Bay unless its liquid wastes will be treated on the premises, or in a public treatment plant having sufficient capacity, so that the effluent would not cause delay in compliance with applicable water quality standards anywhere in the Bay." (BCDC, 1969)

The BCDC requires that no building permits be issued, either for expansion of existing marinas or building of new marinas, unless the vessels using the facilities dump no solid or liquid wastes within the confines of the harbor. Adequate restrooms on shore and pumpout facilities for vessels must be provided in order to obtain a building permit from BCDC.

Table 6 provides a summary of major laws and regulations affecting vessel discharges.

TABLE 6

MAJOR LAWS AND REGULATIONS AFFECTING VESSEL DISCHARGES

Law or Regulation	Administering Agency	Summary of Provisions
Federal		
Federal Water Pollution Control Act Amendments of 1972 (FWPCA), Section 312	Environmental Protection Agency (EPA)	Prevents discharge of untreated or inadequately treated vessel sewage into or upon United States waters and specifies effluent standards for vessels which must be met by all vessels by 30 January 1980.
United States Coast Guard Marine Sanitation Device Regulations	United States Coast Guard (USCG)	Implements EPA discharge standards by certifying marine sanitation devices (MSD) Type I - fecal coliform $<$1,000/100 ml -- no visible solids Type II - fecal coliform $<$200/100 ml -- suspended solids $<$ 150 mg/l Type III - no discharge; holding tank only
State		
California Assembly Bill No. 2581 (Chapter 5 of Division 3, Harbors and Navigation Code) Sections 775 and 776	State Water Resources Control Board (SWRCB)	Section 775 says no state or local agency can place restrictions on MSDs, and pumpout facilities are necessary for conformance with MSD requirements. Section 776 says that by 19 September 1977 marine terminals, as requested by the SWRCB, shall provide pumpout facilities.
California Administrative Code, Title 3, Chapter 3, Subchapter 20	SWRCB	Sets general standards for design, construction, operation, and maintenance of pumpout facilities
Standards for the Removal of Sewage from Vessels (Title 3 of California Administrative Code, Chapter 3, Subchapter 20.1)	SWRCB	Provides standard method for determining which marine terminals shall be required to construct pumpout facilities.
Policy Statement 70-65 of the San Francisco Bay Regional Water Quality Control Board	RWQCB	Recommended installation of pumpout facilities at marine terminals and asked SWRCB to request EPA to declare San Francisco Bay no-discharge waters. No direct actions occurred.
California Administrative Code, Title 3, Chapter 3, Subchapter 20. Sections 2824 and 2829	RWQCB	The RWQCB must inspect and approve the operating and maintenance instructions of pumpout stations for completeness, and inspect the entire facility annually.
California State Health and Safety Code, Sections 4425 and 4431	State Health Department with RWQCB as local enforcement agency	Section 4425 prohibits vessels with toilets from operating on lakes, reservoirs, or fresh-water impoundments unless equipped with no-discharge toilets. Section 4431 says discharge of raw sewage to navigable waters of the State within the confines of a marina or yacht harbor is a misdemeanor.
Regional		
California State Government Code, Section 66632.	San Francisco Bay Conservation and Development Commission (BCDC)	Establishes permitting authority of BCDC. BCDC requires where appropriate that no marina permits be issued unless adequate on-shore restrooms and pumpout facilities are provided.

AREAS OF WATER QUALITY MANAGEMENT DEFICIENCIES

DOCUMENTATION

Vessel pollution is a relatively new area of concern for water quality. Documentation of water quality problems specific to vessel discharges is weak. Past studies have usually examined over-all bacteriological quality of the Bay. However, vessels can be identified as probable sources of pollution problems.

Only one study was found that specifically monitored some waters directly affected by vessel usage. This study showed that a concentrated vessel population discharging wastes within a confined area can cause water quality problems.

ENFORCEMENT

Enforcement responsibilities have been unclear. The Environmental Protection Agency designates the United States Coast Guard as the enforcement agency for ensuring the use of marine sanitation devices on vessels. However, insufficient funding is resulting in a minimal enforcement program.

The USCG will board a vessel "on cause" for some purpose other than checking MSD's. While on board the vessel they will check for the presence of an MSD. However, proper on-board functioning of the device will not be examined. If a vessel does not have the proper MSD, a warning will be given to the vessel operator and USCG will note this fact. If the USCG should board the same vessel, again "on cause" only, and find the MSD to be improper, the operator will receive a fine.

Health Department regulations against raw sewage discharges are being enforced by the RWQCB according to Health Department Officials. However, the RWQCB has no enforcement program for these regulations due to manpower shortages. (Thompson, RWQCB personal communication)

MARINE SANITATION DEVICE

The USCG subjects marine sanitation devices to the following tests as specified in 33CFR159 (Section 159.101-159.131): vibration, shock, rolling, pressure, pressure and vacuum pulse, temperature range, chemical resistance, sewage processing, coliform reduction (for types I and II), and safety tests. If the device passes all tests it is certified. Once a certified device is installed, no "in-use" reliability tests or surveys are conducted. Almost all Type I and II MSD's require chemicals to disinfect the wastes, yet these models can be emptied without disinfection chemicals having been added.

Macerator/chlorinator MSD's (Type I and II) use large amounts of chlorine to meet the effluent standards for coliforms. Chlorine residuals from these devices can be as high as 50 mg/l. This level of chlorine residual in the effluent can have toxic effects on marine habitat in confined areas.

PUMPOUT FACILITIES

The Type III marine sanitation devices are holding tanks which must have their discharges pumped out at a shoreside facility. A recent survey found only 12 operating pumpout facilities in the Bay Area, not nearly enough to serve the estimated currently bearthed vessel population of 15,186.

Regulations have been proposed to provide a standard method of determining which marine terminals shall be required to construct pumpout facilities. This means the San Francisco Regional Water Quality control Board must determine now where pumpout facilities are needed in the Bay Area and then request the State Water Resources Control Board to require the specified marine terminals to install such facilities. An appropriate time schedule for installation will be included in the State Board's order and will vary from terminal to terminal.

REGULATIONS AND IMPLEMENTATION

Regulations appear to be adequately aimed at decreasing pollution from vessels. The implementation and enforcement of these regulations are often inadequate. Several agencies or departments at different levels of government are involved with regulatons pertaining to vessel discharges. Clarification of specific responsibilities often becomes necessary and is very time consuming.

Vessel owners and operators are confused as to how they are affected by the current regulations. Regulations have changed several times and owners are hesitant to make structural changes on their vessel for fear regulations may change again soon.

MANAGEMENT ALTERNATIVES

Various alternatives are available to alleviate if not eliminate the vessel waste pollution problem. These alternative plans, which are described in this section, will be subjected to detailed investigation for possible inclusion in the Environmental Management Plan. They are briefly stated as follows:

- Improve monitoring and documentation of vessel waste pollution.
- Establish effective enforcement procedures.
- Establish Bay Area criteria and approved devices for on-board marine sanitation devices.
- Force all marinas to provide vessel holding tank pumpout facilities.
- Consolidate the various vessel waste regulation and enforcement activities into fewer agencies.

DOCUMENTATION

Funding sources should be sought for developing a documentation program. An agency should set up an on-going documentation program for water quality problems related to vessels on the Bay. Marinas should be consistently and accurately monitored for pollutants related to vessels.

The success of the enforcement program should be part of the documentation. Improperly functioning marine sanitation devices and pumpout facilities should be part of the report. Specific problems and problem areas could be identified and it could be accurately determined if water quality is adequately protected from vessel pollution by existing regulations.

Two possible agencies which might undertake the monitoring program are the RWQCB, and the State Department of Health, through the local County Health Departments. The RWQCB has the mandate to protect the local water quality while the Department of Health has prohibited raw sewage discharge in harbors and marinas and at docks. The identification of an appropriate agency and methods of monitoring will be done at the next stage of plan development.

ENFORCEMENT

Sufficient documentation of current water quality problems may not exist to warrant the State Board to petition EPA to designate San Francisco Bay as no-discharge waters. This means USCG is responsible for enforcing the current regulations for types I, II, and III marine sanitation devices.

Funding does not currently exist for on-board inspection of MSD's on all vessels. With adequate funding USCG could improve their enforcement program beyond certification of MSD's for use and inspecting MSD's when stopping a vessel for some other reason. A well defined program could be announced publicly, and vessel owners and operators would be clearer about their responsibilities for operating an appropriate MSD.

All vessels in the State are registered by the State Department of Motor Vehicles in a manner similar to automobile registration. Vessel inspection for approved MSD devices could be made a part of the registration program. Thus, a first-time or periodic inspections could be instituted to at least ensure that the MSD is on-board a vessel.

The Navy and all commercial and passenger vessels, both domestic and foreign, could be required to have holding tanks or be inspected before entering the Bay to ensure that they dump their sewage and bilge wastes in the ocean.

The Regional Board could set up an enforcement program to ensure that those marine terminals designated for pumpout facilities by the State Board, construct the facility. The RWQCB's program could inspect for proper design, operation, and maintenance of the pumpout facility. Each facility must be capable of handling many types of marine sanitation devices and hook-ups for discharging bilge wastes.

MARINE SANITATION DEVICES

The SWRCB could approve State standards for MSD's which are equivalent to or stricter than EPA standards. Local concerns for water quality effects of unused devices or excess chemical discharge could be answered in "California" or "Bay Area" approved devices.

Holding tank type devices could be required to have standard fittings which could be used with any pumpout facility at any marina.

PUMPOUT FACILITIES

It is recognized that the SWRCB will designate marinas to install sewage pumpout facilities. It is felt that in order to encourage boat owners to use their MSD's properly, pumpout facilities should be easily available at any marina.

Marinas which undergo new construction and require a BCDC permit can be required to install necessary facilities. Methods of requiring existing marinas to add pumpout equipment will be further studied.

IMPLEMENTATION

Vessel owners should be able to reference a single source of information about required devices and installation of these devices. Possible sources are:

- The United States Coast Guard
- The San Francisco Bay Regional Water Quality Control Board
- State Department of Motor Vehicles (who would register such devices)
- State certified pollution control stations at marinas and boat repair facilities. These would be similar to automobile pollution control stations at existing garages.

REFERENCES

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APPENDIX A

San Francisco Bay

Marinas and Sewage Pumpout Facilities

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: Alameda County

#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
1-1	Aeolian Yacht Club	45		X	
1-2	Alameda Marina	483		X	
1-3	Alameda Yacht Harbor	420		X	
1-4	Ballena Bay Yacht Harbor	485	1		24
1-5	Barnhill Marina	70		X	
1-6	Berkeley Marina	1,000	1		24
1-7	Boat Mart	2		X	
1-8	Del's Boat Harbor	50		X	
1-9	Emeryville Marina	295	2		24
1-10	Evan's Radio Dock	50		X	
1-11	Jack London Marina	230		X	
1-12	Lani Kai Harbor	48		X	
1-13	Livermore Yacht Club	27		X	
1-14	Oakland Marina	97		X	
1-15	Oakland Yacht Club	100		X	
1-16	Pacific Marina	300		X	
1-17	Portobello Marina	55		X	
1-18	Red Sails	12		X	
1-19	Sailboats, Inc.	150		X	
1-20	San Leandro Marina	475	2		9 a.m. - 5 p.m.
1-21	Seabreeze Yacht Center	100		X	

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: Contra Costa County					
#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
2-1	Anchor Marine	68		X	
2-2	Beacon Harbor	30		X	
2-3	Bethel Harbor	85		X	
2-4	Big Break Marina	400		X	
2-5	Bob's Marina	51		X	
2-6	Boyd's harbor	50		X	
2-7	Brickyard Cove Harbor	21		X	
2-8	Brown's Marina	21		X	
2-9	Caliente Isle Yacht Club	48		X	
2-10	Carol's Harbor	12		X	
2-11	Carter's	12		X	
2-12	Catchalot Harbor	15		X	
2-13	Channel Marina Yacht Harbor	71		X	
2-14	Cruiser Haven Yacht Harbor	70		X	
2-15	Decker's Richmond Yacht Harbor	63		X	
2-16	Delta Marine Center	127		X	
2-17	Delta Resort Co.	18		X	
2-18	Doc's Marina				
2-19	Dowrelio's Yacht Harbor	85		X	
2-20	Driftwood Marina	150		X	
2-21	Farrar Park Harbor	97		X	
2-22	Frank's Fishing Resort	68		X	
2-23	Gregg's Motel & Harbor	18		X	
2-24	Harris Yacht Harbor	130		X	
2-25	Hartman's Harbor	29		X	
2-26	Island Park Marina	88		X	
2-27	Lauritzen Yacht Harbor	198		X	
2-28	Leisure Landing	160		X	
2-29	Lloyd's Holiday Harbor	128		X	
2-30	Martinez Small Craft Harbor	366	1		7 a.m. - 8 p.m.
2-31	McAvoy Yacht Harbor	200		X	
2-32	Orwood Resort	85		X	
2-33	Petri Yacht Harbor	268		X	
2-34	Pittsburg Yacht Harbor	188		X	
2-35	Prince Harbor	30		X	

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: Contra Costa County

#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
2-36	Pt. San Pablo Yacht Club	33		X	
2-37	Pt. San Pablo Yacht Harbor	175	1		24
2-38	Red Rock Marina	140		X	
2-39	Remburg's Harbor	76		X	
2-40	Richard's Yacht Center	29		X	
2-41	Richmond Yacht Harbor	54		X	
2-42	River's Harbor	14		X	
2-43	Riverview Resort	13		X	
2-44	Rodeo Marina	140		X	
2-45	Russo's Harbor	100		X	
2-46	S & H Boatyard				
2-47	Sam's Harbor	32		X	
2-48	San Joaquin Yacht Harbor	77		X	
2-49	Sea Horse Marina	15		X	
2-50	Seven Bells	13		X	
2-51	Standard Oil Rod & Gun Club	75		X	
2-52	Wharf Yacht Sales	2		X	
2-53	Willow Park Marina	42		X	
2-54	Wood's Yacht Harbor	64		X	
2-55	Viking Harbor	50		X	

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: Marin County

#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
3-1	Angel Island State Park	36	1		Closed
3-2	Clipper Yacht Harbor	700		X	
3-3	Corinthian Yacht Club	80		X	
3-4	Golden Hinde Boatel	35		X	
3-5	Inverness Yacht Club	10		X	
3-6	Kappas Marina	267		X	
3-7	Loch Lomond Marina	320		X	
3-8	Lowrie Yacht Harbor	109		X	
3-9	Marconi Cove	30		X	
3-10	Marin Yacht Harbor	88		X	
3-11	Mira Monte Marina	10		X	
3-12	Novato Marina	15		X	
3-13	Paradise Cay Yacht Harbor	180		X	
3-14	Pier 15	4		X	
3-15	San Francisco Yacht Club	180		X	
3-16	San Rafael Yacht Harbor	180		X	
3-17	Sausalito Cruising Club	10		X	
3-18	Sausalito Public Ramp	3		X	
3-19	Sausalito Yacht Club	3		X	
3-20	Sausalito Yacht Harbor	500		X	
3-21	Trade Winds	26		X	

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: Napa County					
#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
4-1	Breezy Fishing Resort	20		X	
4-2	City of Napa Marina				
4-3	Holiday Harbor Grotto	8		X	
4-4	Moore's Resort				
4-5	Napa Boat Club	8		X	
4-6	Napa Valley Marina	100		X	

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: San Francisco

#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
5-1	Fisherman's Wharf	198		X	
5-2	Gas House Cove Marina	-			
5-3	Golden Gate Yacht Club	35		X	
5-4	Mariposa Hunters Pt. Yacht Club	10			
5-5	Mission Rock Resort	27		X	
5-6	San Francisco Marina	733	2		24
5-7	The Ramp				

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: San Mateo

#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
6-1	Coyote Point Harbor	480	1		8 a.m. - 5 p.m.
6-2	Darcy's Marina	5		X	
6-3	Docktown Marina				
6-4	Oyster Point Marina	287		X	
6-5	Pete's Harbor	128		X	
6-6	Redwood City Marina	150		X	
6-7	Redwood Marina	34		X	
6-8	Redwood Shores	150		X	
6-9	San Pedro Pt. Boat House	12		X	

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: Santa Clara					
#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
7-1	Alviso Marina	80		X	
7-2	Palo Alto Yacht Club	16		X	
7-3	Palo Alto Yacht Harbor	150		X	

APPENDIX TABLE A-I

San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: Solano					
#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
8-1	Bay Terrace Yacht Harbor	52		X	
8-2	Collinsville Fishing Resort	25		X	
8-3	Glenn Cove Marina	68		X	
8-4	Hidden Harbor	20		X	
8-5	Marine City				
8-6	Napa Valley Fishing Resort				
8-7	Paul's Boat Harbor	24		X	
8-8	Pierce Harbor	15		X	
8-9	Solano Yacht Harbor	26		X	
8-10	Suisun Pacific Marina	200		X	
8-11	Vallejo Boat Center	30		X	
8-12	Vallejo Municipal Marina	57	1		Closed
8-13	Vallejo Yacht Club	116		X	

APPENDIX TABLE A-I

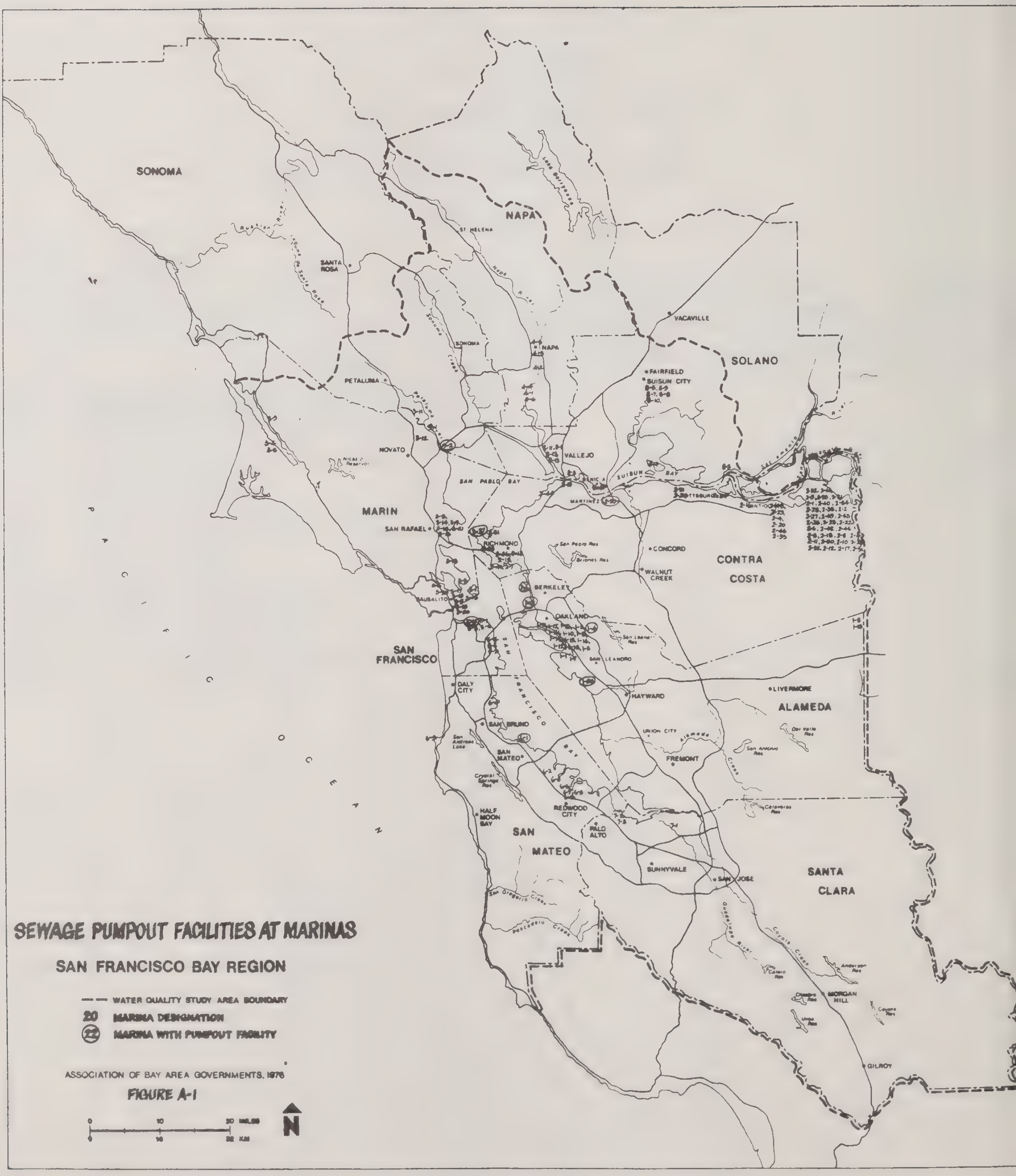
San Francisco Bay

Marinas and Sewage Pumpout Facilities

March 1977

COUNTY: Sonoma

#	NAME OF FACILITY	BERTHS	PUMPOUT FACILITY		
			YES	NO	OPERATING HOURS
9-1	Gilardi's Fishing Resort	4		X	
9-2	Shellmaker Marina	44	1		



SEWAGE PUMPOUT FACILITIES AT MARINAS
SAN FRANCISCO BAY REGION
WATER QUALITY STUDY AREA BOUNDARY
20 MARINA DESIGNATION
MARINA WITH PUMPOUT FACILITY
ASSOCIATION OF BAY AREA GOVERNMENTS, 1976
FIGURE A-1
N
SONOMA
NAPA
SOLANO
MARIN
CONTRA
COSTA
SAN
FRANCISCO
SAN
MATEO
ALAMEDA
SANTA
CLARA
SANTA ROSA
ST HELENA
SONOMA
NAPA
VACAVILLE
FAIRFIELD
SUISUN CITY
PETALUMA
NOVATO
VALLEJO
SAN PABLO BAY
SUISUN BAY
MARTINEZ
PITTSBURG
ANTIOCH
SAN RAFAEL
RICHMOND
CONCORD
WALNUT CREEK
BERKELEY
SAUSALITO
OAKLAND
SAN LEANDRO
DALY CITY
HAYWARD
LIVERMORE
SAN BRUNO
UNION CITY
SAN MATEO
FREMONT
HALF MOON BAY
REDWOOD CITY
PALO ALTO
SUNNYVALE
SAN JOSE
MORGAN HILL
GILROY
SAN FRANCISCO BAY
PACIFIC OCEAN

APPENDIX B

PROPOSED SWRCB REGULATIONS ON

VESSEL WASTE PUMPOUT FACILITIES

RECEIVED
APR 1 8 1977
ABAG
CLEARING HOUSE

STATE OF CALIFORNIA—THE RESOURCES AGENCY EDMUND G. BROWN JR., Governor

STATE WATER RESOURCES CONTROL BOARD

P. O. BOX 100 • SACRAMENTO 95801

NOTICE OF PROPOSED ADOPTION OF REGULATIONS
OF THE STATE WATER RESOURCES CONTROL BOARD

NOTICE IS HEREBY GIVEN that the State Water Resources Control Board, pursuant to the authority vested by Section 1058 of the Water Code, and to implement, interpret or make specific Chapter 6 (commencing with Section 775) of Division 3 of the Harbors and Navigation Code, the State Water Resources Control Board hereby proposes to add regulations in new Subchapter 20.1, Chapter 3, Title 23, California Administrative Code, as follows:

Subchapter 20.1: Designation of Marinas to Provide
Adequate Sewage Retention Pumpout Facilities

Article 1. General Provisions

2831. General. Pursuant to Chapter 6 (commencing with Section 775) of Division 3 of the Harbors and Navigation Code the State Board shall, as needed for the protection of water quality, require any person lawfully vested with the possession, management, or control of a marine terminal to provide adequate vessel sewage retention device pumpout capability, at locations which are convenient and accessible to vessel users.

It is the intent of these regulations to provide a standard method of determining which marine terminals shall be required to construct pumpout facilities.

2832. Definitions. The following definitions shall apply to this subchapter:

(a) "State Board" means the State Water Resources Control Board.

(b) "Regional Board" means any California Regional Water Quality Control Board for a Region as specified in Section 13200 of Porter-Cologne Water Quality Control Act.

(c) "Person" includes an individual, firm, corporation, association, and a partnership. "Person" also includes any city, county, district, the State or any department or agency thereof and the United States to the extent authorized by federal law.

(d) "Marine terminal" means any shoreside installation including, but not limited to, private or public marinas and ocean terminals providing mooring, docking, berthing, and other facilities at or near surface waters of the State for the use of vessels, including vessels engaged in interstate and foreign commerce. For the purposes of this subchapter, "marine terminal" does not include boat launching ramps or facilities for the mooring of vessels for less than one day or dockage adjacent to and serving private residences in areas where pumpout facilities are available or such other facilities as may be designated by the State Board with the advice and consent of the Department of Navigation and Ocean Development.

(e) "Sewage" means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes.

(f) "Pumpout facility" means any facility or other means used to transfer sewage from a sewage retention device aboard a vessel to storage or disposal facilities.

(g) "Vessel" means every watercraft or other contrivance used or capable of being used as a means of transportation on the waters of the State, excepting foreign and domestic vessels engaged in interstate or foreign commerce upon the waters of the State.

(h) For purposes of this Subchapter, "waters of the State" means any water surface including saline waters, within the boundaries of the State.

Article 2. Administrative Procedures

2833. Regional Board Request. Each Regional Board, after determining the need for pumpout facilities within its region, shall request the State Board to require specified marine terminals to install pumpout facilities where necessary to protect water quality.

2833.1. Contents of Regional Board Request for Pumpout Facilities. Requests for requiring marine terminals to install vessel waste pumpout facilities shall be forwarded to the State Board by the Regional Board. Each request shall be based upon the guidelines contained in Section 2834.1 and shall include the following as well as any other information requested by the State Board.

(a) Designation of the area where additional facilities are needed.

(b) Explanation of the need for additional pumpout facilities within the area including:

(1) An estimate of the number of vessels with sewage retention devices requiring pumpout facilities.

(2) The location of each marine terminal.

(3) The location and capacity of existing pumpout facilities.

(c) Recommendations as to which marine terminal or terminals should install pumpout facilities, the capacity of the facilities which should be installed, and reasons for such recommendations.

(d) The name, owner, and address of each marine terminal recommended pursuant to (c) above.

(e) Copies of any comments received as a result of the Notice of Pumpout Facility Need.

2833.2. Notice of Pumpout Facility Need. Prior to requesting the State Board to require a marine terminal to install pumpout facilities the Regional Board shall prepare a Notice of Pumpout Facility Need and shall forward a copy of the notice to known interested agencies and persons. The Regional Board shall publish the notice at least once in a newspaper of general circulation in the proposed area of pumpout facility need. Proof of publication of the notice shall be submitted to the State Board The notice shall provide a 30-day comment period in which interested persons may comment upon the notice. The notice shall contain:

(a) A designation of the area considered by the Regional Board.

(b) The reason pumpout facilities are believed to be necessary for the protection of water quality in that area.

(c) The names, locations, and addresses (if available) of marine terminals which may be required to install pumpout facilities.

2833.3. Hearings by Regional Boards. Upon the request of the State Board, any interested person, or upon its own motion, the Regional Board may hold a public hearing prior to requesting the State Board to require a marine terminal to install pumpout facilities. The Regional Board shall transmit any comments received together with their request to the State Board.

2833.4: Hearings by State Board. Upon the request of any interested person, or upon its own motion, the State Board may hold a public hearing regarding a proposed requirement that a marine terminal install pumpout facilities.

2834. Further Procedures. The State Board may require marine terminals to install vessel waste pumpout facilities after consideration of the request of the Regional Board, the record of any Regional Board or State Board hearing and the following guidelines. Copies of the order requiring installation of pumpout facilities shall be sent to the Regional Board, the marina owner, and to other marine terminals within the area of activity.

2834.1. Guidelines for Marine Terminal Selection.

(a) First priority to install pumpout facilities shall be assigned to publicly owned marine terminals.

(b) Second priority shall be assigned to private marine terminals, in the event there are no public marine terminals in the area.

(c) In addition, the State Board and Regional Boards shall, as a minimum, consider at least the following factors:

(1) Availability of private marine terminals with pumpout facilities not available to the general public.

(2) Priority consideration should be given to marine terminals with fuel docking capability.

(3) The number of boats with sewage retention devices berthed at each marine terminal in the area.

(4) The depth of water required for the vessels that will be using the pumpout facility.

(5) The expense of installing a pumpout facility and access to a means of disposing of or treating the sewage.

2835. Installation Time. Since the time necessary for the installation of pumpout facilities may vary, when the State Board requires a marine terminal to install a pumpout facility, an appropriate time schedule shall be included in the order.

2836. Design, Construction, Operation, and Maintenance. The design, construction, operation, and maintenance of the pumpout facility shall be in accordance with Subchapter 20, Chapter 3, Title 23 of the California Administrative Code (commencing with Section 2815).

The State Water Resources Control Board has determined that there are no state mandated local costs under Section 2231 of the Revenue and Taxation Code as a result of the foregoing regulations because the regulations are not executive regulations by virtue of Section 2209 of the Revenue and Taxation Code.

NOTICE IS ALSO GIVEN that any interested person may present statements to the Board in writing relevant to the action proposed on or before June 1, 1977, at P.O. Box 100, Sacramento, California 95801. At that time, or at any time thereafter, the Board may adopt the proposed regulations without further notice.

Dated: April 14, 1977

W. R. Attwater
for
Bill B. Dendy
Executive Officer

WATER QUALITY MANAGEMENT PLANS

EQUIVALENT HEAVY METALS LOADING FACTORS; PRESENT POINT SOURCE HEAVY METALS LOADING RATES IN THE BAY REGION 208 PLANNING AREA

TECHNICAL MEMORANDUM NO. 7
FEBRUARY 24, 1977

In considering the question of heavy metals inputs to the Bay, it is necessary to compare the relative inputs from different categories of sources. One starting point, then, is a compilation of present heavy metals loadings from point sources. It will be useful, also, to have a method available which will facilitate comparing and assessing the relative significance of metals discharges from various sources. This paper addresses these two topics.

Equivalent Heavy Metals Loading Factors

In dealing in the aggregate with heavy metals inputs to a receiving water, it is often desirable to quantify all metals as a group using a single parameter. Use of such a parameter in comparing metals inputs from different categories of sources can be considerably more convenient than dealing separately with each metal.

In past studies, it has often been the practice to add together directly the loadings of the different metals species under consideration. This can be misleading, however, since various metals have markedly different toxicities; further, the relative quantities of the different metals can vary substantially from one source to the next. Thus, 100 pounds of gross heavy metals from one source may be more toxic than 200 pounds from another source.

It is proposed here to calculate an equivalent heavy metals loading, based on the relative toxicities of the different species. The actual loadings of the different metals will be adjusted using a set of loading factors; the adjusted loadings will then be added to obtain a single equivalent loading. Because control of toxic discharges is undertaken in order to protect the environment, the most appropriate reference value for each metal is the chronic toxicity level, or concentration at which sublethal effects on more sensitive species begin to be felt.

The background data and loading factors for the metals to be considered here are given in Table 1. Two data sources were used:

- "Water Quality Criteria 1972", Environmental Studies Board of National Academy of Sciences - National Academy of Engineering, 1972 (values cited as "constituting a hazard in the marine environment")

- "Ocean Plan Review Status Report", California State Water Resources Control Board, October 1976 (Appendix B)

The two sets of values for chronic toxicity are in generally good agreement, though not identical for most metals. The effective toxicity used here for each metal is the geometric mean of the values from the two sources. In Table 1, nine metals are arranged in order of increasing toxicity. The median position is occupied by chromium, and it has been assigned a loading factor of 1.0. Loading factors for other metals have been calculated from the ratios of chronic toxicity levels. Thus mercury, the most toxic, has the highest loading factor.

Table 1 also includes estimated background levels for the ocean (not San Francisco Bay) taken from the "Ocean Plan Review". The effective chronic toxicity levels used range from several to many times the background level. Since the difference between background and chronic toxicity level is in all cases large relatively, and because all the data is rather approximate, no attempt has been made to account for background levels in arriving at loading factors.

There are recognized synergistic effects among at least several of the metals, notably copper, cadmium and zinc; that is, two metals present together can have toxic effects at lower concentrations than would be required for similar effects from either one separately. Synergistic effects are complex and the data are quite limited; synergism is probably less important at low concentrations; and finally, the equivalent metals loading proposed here is a fairly blunt instrument. For these reasons, this formulation does not attempt to account for synergism.

An example of the use of the loading factors is given in Table 2. Two hypothetical waste discharges of equal flow rate but dissimilar metals loadings are compared. The assumed metals concentrations are all within the range of existing municipal discharges within the Bay Area, although the relative proportions may not be typical. As may be seen at the bottom of Table 2, while the two hypothetical discharges have virtually the same gross (actual total) metals loading, one discharge has an equivalent loading approximately 60% higher than the other. Thus (questions of location aside) the one discharger is probably contributing at a substantially higher rate to any metals problems than the other.

Another useful feature of this proposed tool emerges from a perusal of Table 2. Since the equivalent loadings constitute a recalculation of loadings to a basis of uniform chronic toxicity level for all metals, the relative importance of the various metals in the discharge is apparent at a glance. This is true for a single discharge or for the totals for a sub-region or the entire region.

Point Source Heavy Metals Loadings

Table 3 summarizes heavy metals loadings to San Francisco Bay from municipal treatment plants. Most of the data for this summary was assembled by the San Francisco Regional Water Quality Control Board from dischargers' self-monitoring reports. Some estimates were made where individual data items were not available. The discharges are given in Table 3 metal by metal and county by county. Silver is not included because data is not available; the amount of silver discharged is believed to be small compared to other metals.

The total gross metals loading, from the summarized data, is 2570 lbs per day. The total equivalent metals loading is 3520 lbs per day. The latter figure may be used to compare with metals discharges from other sources. Discharge of copper is seen to be most important among the metals, as regards municipal plant effluents, resulting from both high gross discharge and a higher-than-average toxicity (loading factor). Zinc (high discharge) and mercury (high toxicity) are also important. Alameda County plants have high discharges of all three of these metals and as a group account for about half the total equivalent metals loading to the Bay.

Table 4 gives similar information for coastside municipal plants discharging to the ocean. Again, copper, mercury and zinc are the most significant among the metals released. The total metals loading direct to the ocean is much smaller than that to the Bay, as would be expected from the much smaller volume discharged.

Insufficient data is available from self-monitoring reports from industrial dischargers to be able to arrive at figures for total metals loading from discrete industrial sources. In all counties except Contra Costa County, non-discrete discharges to municipal systems constitute the major portion of total industrial discharges (note high metals loadings in Table 3 for Alameda, San Francisco and Santa Clara Counties). Task Report IV-2 of the San Francisco Bay Basin Water Quality Control Study gives a gross heavy metals loading for Contra Costa County in 1970 of 550 lbs per day (comparable figures for other counties are not given). Based on this, a crude estimate for present gross heavy metals loading to the Bay would be 1000 lbs per day for discrete industrial sources in all counties; for total equivalent metals loading, 1500 lbs per day. More work will be done in this area to develop other data sources in order that more reliable figures can be provided.

It should be emphasized that this paper is intended to deal only with metals inputs to the Bay from point sources. Nonpoint source inputs and the fate of metals reaching the Bay will be discussed in other papers.

TABLE 1: EQUIVALENT HEAVY METALS LOADING FACTORS

Metal	Background Level*	Chronic Toxicity Levels*		Geometric Mean Chronic Toxicity*	Loading Factor
		Ocean Plan Review	Water Quality Criteria		
Nickel	2	100	100	100	0.45
Lead	0.04	100	50	71	0.63
Zinc	8	40	100	63	0.71
Arsenic	3	---	50	50	0.90
Chromium	0.2	20	100	45	1.00
Copper	2	10	50	22	2.0
Cadmium	0.1	10	10	10	4.5
Silver	0.16	0.57	0.5	0.53	85
Mercury	0.06	1.0	0.1	0.32	140

*Concentrations in ug/1

TABLE 2: EQUIVALENT HEAVY METALS LOADINGS, ILLUSTRATION

Parameter	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Loading Factor	0.90	4.5	1.0	2.0	0.63	140	0.45	0.71
Effluent A: (1)								
Concentration (2)	10	30	50	200	50	1.5	50	180
Loading (3)	0.8	2.5	4.2	16.7	4.2	0.13	4.2	15.0
Equivalent Loading (3)	0.7	11.3	4.2	33.4	2.6	18.2	1.9	10.7
Effluent B: (1)								
Concentration	10	10	80	80	80	0.5	80	240
Loading	0.8	0.8	6.7	6.7	6.7	0.04	6.7	20.0
Equivalent Loading	0.7	3.6	6.7	13.4	4.2	5.6	3.0	14.2

(1) Assumed flow rate 10 MGD
(2) Assumed concentrations in ug/l
(3) Loadings and equivalent loadings in lbs/day

TOTALS

Effluent	Gross Metals Loading lbs/day	Equivalent Metals Loading lbs/day
A	47.7	83.0
B	48.4	51.4

TABLE 3: METALS LOADINGS TO SAN FRANCISCO BAY FROM MUNICIPAL DISCHARGERS, 1975

County	Discharge, Pounds Per Day							
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Alameda	9.7	13.5	137	440	93	1.30	84	556
Contra Costa	5.8	4.0	8	23	18	0.31	15	56
Marin	1.5	1.4	2	7	7	0.41	7	13
Napa	0.4	0.4	3	1	2	0.03	1	3
Solano	1.8	3.2	1	21	29	0.07	2	6
Sonoma	0.4	0.4	16	1	2	0.04	2	5
San Francisco	9.5	11.0	119	38	80	1.10	38	140
Santa Clara	4.1	19.4	34	115	21	0.60	51	120
San Mateo	3.3	2.8	27	24	15	0.43	32	53
Total to Bay	36.5	56.1	347	670	267	4.29	232	952
Loading Factor	0.9	4.5	1.0	2.0	0.63	140	0.45	0.71
Equivalent Loading	33	252	347	1340	168	601	104	676
Gross Metals Loading Total: 2570 lbs/day								
Equivalent Metals Loading Total: 3520 lbs/day								

Note: This table is based primarily on data assembled from dischargers' self-monitoring reports by the S.F. Regional Water Quality Control Board. Because the original data was based typically on only a few samples per discharger and because some estimation was required in preparing this table, the values given are quite approximate.

TABLE 4: METALS LOADINGS TO PACIFIC OCEAN
FROM MUNICIPAL DISCHARGERS, 1975

County	Discharge, Pounds Per Day							
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
San Francisco	0.3	0.7	2	15	10	0.4	4	30
San Mateo	0.9	0.4	1	5	5	0.04	2	19
Total to Ocean	1.2	1.1	3	20	15	0.44	6	49
Loading Factor	0.9	4.5	1.0	2.0	0.63	140	[illegible]	0.71
Equivalent Loading	1	5	3	40	9	62	3	35

Gross Metals Loading Total: 95 lbs/day

Equivalent Metals Loading Total: 160 lbs/day

Note: This table is based primarily on data assembled from dischargers' self-monitoring reports by the S.F. Regional Water Quality Control Board. Because the original data was based typically on only a few samples per discharger and because some estimation was required in preparing this table, the values given are quite approximate.

WQ/Tech Memo 8/February 28, 1977

Peter Chiu

WATER QUALITY MANAGEMENT PLANS

EXISTING MUNICIPAL WASTEWATER MANAGEMENT AGENCIES IN THE SAN FRANCISCO BAY REGION

TECHNICAL MEMORANDUM NO. 8

At present, there are more than 150 public agencies responsible for the treatment and/or collection of municipal wastewater in the nine Bay Area counties. More than 50 of these agencies are incorporated cities. Others are special districts. About 86 of these 150 agencies have their own treatment facilities.

The attached map shows the service area boundaries of the agencies and locations of the treatment plants and outfalls. Agencies with treatment plants are listed as municipal dischargers. Agencies responsible only for wastewater collection are listed as tributary agencies. Participating agencies of joint powers agreements for wastewater management are also listed.

Specific comments, corrections, or additions on the listing of agencies, their service area boundaries, and locations of treatment plants and outfalls are hereby requested.

A 4' x 3' map is available on request.

WQ/Tech Memo 9/2-28-77
B. Fitting

WATER QUALITY MANAGEMENT PLAN

FINANCING MUNICIPAL WASTEWATER FACILITIES

TECHNICAL MEMORANDUM NO. 9

FEBRUARY 28, 1977

INTRODUCTION (EXECUTIVE SUMMARY)

Wastewater collection and treatment is annually a multi-billion dollar venture. Wastewater agencies at the local level of government are for the most part responsible for finding and obtaining the money to build, operate and maintain their systems. The purpose of this paper is to list and describe the programs currently available for this purpose.

The paper emphasizes financing mechanisms available to local agencies. This is where wastewater collection and treatment programs are implemented. Sources of money available to regional, State and Federal authorities that plan for and regulate local wastewater agencies are not covered.

Financing programs for wastewater collection and treatment agencies are found at the Federal, State and local levels. Federal and State mechanisms basically consist of capital subsidies for facility construction. Local money is also necessary for facility construction, but municipalities and special districts must operate and maintain their wastewater collection and treatment systems. Therefore, the paper also includes descriptions of revenue sources as well. The uses of the financing mechanisms - for capital or revenue, for construction, operation or maintenance, for sewage collection or treatment facilities - are described under each heading.

The paper is organized by level of government where money is obtained. The first group of programs includes those at the Federal level. The second set consists of State programs, followed by a third group at the local level.

For each program there is a brief description and a listing of its advantages and disadvantages. A short review of the program's funding and budgetary trends is given, followed by an example or two of its use in the San Francisco Bay Area. In many instances, a contact person is listed who can provide further information if desired.

SOURCES OF MONEY TO FINANCE CONSTRUCTION, OPERATION AND MAINTENANCE OF MUNICIPAL WASTEWATER SYSTEMS

A. FEDERAL SOURCES

1. CONSTRUCTION GRANTS FOR WASTEWATER TREATMENT WORKS

Brief Description

The construction of municipal sewage treatment plants is normally financed by a mix of Federal, State and local money. The 1972 Amendments to the Federal Water Pollution Control Act, P.L. 92-500, authorize in Section 201 grants of up to 75 percent of the capital costs for construction of publicly owned wastewater treatment works. The program is of major importance, and virtually all wastewater treatment facilities receive "201" assistance of some kind.

Collection systems also are fundable under the Federal law. Under California grant regulations, however, they are not usually considered of high enough priority unless they alleviate designated health hazards--created by overdependence on septic tanks, for example. Facility operation and maintenance are not grant-eligible.

Grants under this program are administered by the U. S. Environmental Protection Agency (EPA). In California the administration of the program has been delegated by EPA to the State Water Resources Control Board (SWRCB). Projects that are grant-eligible are evaluated, approved and ranked by SWRCB prior to funding because only the projects of highest priority will be funded during a given fiscal year.

Project ranking criteria center on the degree to which proposed facilities alleviate health hazards and water quality violations.

Federal money with State approval and program administration, however, means that Federal and State conditions will be placed on funding approval. Projects must meet Federal effluent standards and State water quality standards. They must incorporate and follow Federal and State regulations of facility operation and maintenance. Local authorities must require reimbursement from industrial users for their share of capital costs.

Most importantly from the local point of view, the State's population projections will be used in determining the capacity of the treatment works that will be eligible for Federal and State subsidy. The State uses more restrictive projections for projects located in critical air basins. A community wishing to build a system to accommodate growth in excess of the State's projections must finance the additional capacity without Federal and State contributions.

Advantages

1. The "201" program is well funded at present. Several billion dollars nationwide per fiscal year have been the recent appropriations, and the amount has been growing rapidly.

2. The 75 percent Federal contribution alleviates local and State burdens for wastewater control to an enormous extent.

3. Money is available for project planning, design, and actual construction of treatment works, and for high priority collection sewers.

4. Priority listing by the SWRCB means that projects having greater beneficial impact on the State's water quality can be scheduled before those of lesser importance.

Disadvantages

1. Actual project funding is subject to the Federal budgetary process. This money was at one time subject to impoundment. It is also possible that the "201" program may begin to decline in the next few years.

2. Project operation and maintenance are not grant-eligible.

3. Only that portion of a collection system alleviating a designated health hazard is likely to obtain Federal assistance under this program.

4. Federal restrictions have been described by some officials as too excessive and not tolerant of local growth and development policies.

Funding and Budgetary Trends

Nationally, the total obligations during Fiscal Year 1975 were $4,226,935,904. This amount is expected to rise to more than $6 billion during Fiscal Year 1977. Of this money, hundreds of millions of dollars have been spent in the Bay Area. The short-term trend is up, but the program may begin to decline in a few years.

Examples of Use in the Bay Area

There are many examples in the Bay Area. Two of the largest projects are:

1. Addition of secondary treatment by the East Bay Municipal Utility District, for which a "201" grant of $56 million was awarded in FY 1972.

2. San Jose/Santa Clara advanced treatment improvements, for which a Federal grant of $59 million was approved in FY 1974.

Scores of projects have not yet reached the construction stage. Among these are portions of San Francisco's system, for which the total Federal awards may exceed $1 billion.

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2. WATER AND WASTE DISPOSAL SYSTEMS FOR RURAL COMMUNITIES

Brief Description

The Farmers Home Administration (FmHA) in the U. S. Department of Agriculture conducts a program of grants and Federally guaranteed or insured loans for rural waste disposal systems. Applicants may be cities, counties, or special districts, but the service area for the project can not include a city or town larger than 10,000. To be fundable under this program, a wastewater authority must demonstrate that it has the legal authority to undertake the proposed project, but that it is unable to finance its share of the project through its own resources or through commercial credit at reasonable rates and terms.

Loans are much more common than grants and usually work in the following manner. General obligation bonds are authorized by the electorate to finance the local share of a wastewater project--collection and/or treatment facilities. However, because of the size of the community or project revenues, the bonds can not be sold at reasonable rates on the commercial market. In this instance, the Farmers Home Administration may buy the bonds at a specified interest rate, if all other conditions are satisfied. The Federal agency is then repaid by means of ad valorem property taxes, wastewater system user charges, or other system revenues.

Advantages

1. In grant- and loan-eligible areas, this program can be used to supply the local share--i.e., that portion of the funding not granted from the U. S. Environmental Protection Agency or the State Water Resources Control Board--for both collection and treatment works. This share may differ depending on the eligibility of project.

2. Rural areas which would otherwise not be able to generate sufficient capital for relieving public health hazards caused by overdependence on septic tanks can benefit greatly from this program.

3. The flexibility of the program is augmented somewhat by the availability of both grants and loans.

Disadvantages

1. FmHA grants and loans are available only in rural service areas where there are no communities greater than 10,000.

2. The program can be used only upon a showing that normal financing techniques will not supply adequate capital at reasonable terms for needed projects.

3. FmHA money is not available for project operation and maintenance.

Funding and Budgetary Trends

Total nationwide obligations during Fiscal Year 1975 were approximately $470 million in loans and $157 million in grants. The amount for loans is expected to continue into FY 1977 at the 1975 level, whereas grants may decline somewhat. The amount of this money used for wastewater facilities in the Bay Area is quite small.

Examples of Use in the Bay Area

Because of the heavily urbanized nature of the Bay Area, the FmHA program is not in widespread use, either in terms of number of projects or amount of funding. Point Reyes is one of the few current instances of a Bay Area community which attempted to use the program. This community intended to use this money to cover the local share for constructing both collection and treatment facilities. However, voters in the service area did not approve a general obligation bond issue, and the Federal agency would not make a loan without this form of security. Other examples include Rio Vista, which applied to FmHA to loan the city the local share of constructing secondary treatment facilities, and the Windsor County Water District, which applied for FmHA assistance in constructing sewer lines.

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3. COMMUNITY DEVELOPMENT BLOCK GRANTS

Brief Description

The U. S. Department of Housing and Urban Development (HUD) administers a program of Community Development Block Grants which can be used in certain instances to fund wastewater

collection facilities. Assistance is available to communities both as "entitlement grants" and "discretionary grants." Entitlement grants are allocated to communities over 50,000 and to "urban counties" by a formula based on the community's poverty level, the presence of overcrowded housing, and total population. Discretionary grants are available to all communities regardless of size and are distributed on a project-by-project basis.

Under the program, a sanitary or storm sewer project can be financed but wastewater treatment works cannot. Block grant money, moreover, can in a few cases be used to supplement funds available from EPA under that agency's "201" program. Pursuant to Federal and State regulations, sanitary sewer projects will likely be accorded high enough priority for 75 percent construction funding under Section 201 if the existing facilities are designated a health hazard. With an additional 12-1/2 percent money being available from the State Water Resources Control Board (discussed in a section below), block grant money might be available for some or all of the remaining 12-1/2 percent share, which would normally be covered by local funds. If a health hazard has not been cited, the sanitary sewer would probably not be of high enough priority for funding by EPA and SWRCB, with the result that Block Grant money could conceivably fund up to 100 percent of a collection system project.

In practice, block grant money for sewers is used almost exclusively to finance very small projects. Cities eligible for entitlement grants are already sewered for the most part, and thus entitlement money will be useful only for the occasional small project. Discretionary grants are available to all communities, but the budget is severely limited. There is strong competition among an applicant's public works projects for block grant funds.

Advantages

1. The program provides a potential 100% source of Federal funding for constructing sewers in areas without designated health hazards.

2. If a community's sanitary sewer system is of high enough priority that it will be eligible for EPA and SWRCB funds, block grant money might conceivably pay for some or all of the non-Federal share.

3. The program has billions of dollars for communities that normally qualify for HUD assistance.

Disadvantages

1. Because of the population cutoff for entitlement grants, many Bay Area communities are not eligible for this funding. All communities are eligible for Discretionary Grants, but the amount of available money is much smaller.

2. The overall program is intended to alleviate poverty and substandard housing conditions, and thus other local activities may have higher priority for block grant funding.

3. The overall wastewater collection system is in place for most communities, except some small towns using septic tanks. Therefore, the program is used mostly for single sewer lines and small projects.

4. Treatment facilities are not grant-eligible, nor is the operation and maintenance of sewer lines.

Funding and Budgetary Trends

Entitlement grants of $1.855 billion were made nationwide for all purposes in Fiscal Year 1975. This is expected to climb to $3.248 in FY 1977. The Bay Area's share has recently been in the $70-80 million range per year.

Discretionary grants of approximately $39 million were made in Fiscal Year 1975, with anticipated grants of about $600 million by FY 1977. However, only a very small portion of this money is used for wastewater facilities.

Examples of Uses in the Bay Area

San Mateo County and the city of Vallejo have used entitlement grant funds to construct relatively short stretches of sanitary sewer lines.

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4. LOCAL PUBLIC WORKS CAPITAL DEVELOPMENT AND INVESTMENT PROGRAM

Brief Description

The Public Works Employment Act of 1976 was passed by Congress and signed into law by the President in July 1976. Title I of the Act, which is administered within the Department of Commerce by the Economic Development Administration (EDA), authorizes grants to states, cities, counties, and other political subdivisions for purposes of constructing public works projects. The expressed purpose of the legislation is to provide employment opportunities in areas of high unemployment and thereby to stimulate the nation's economy.

The Act presently requires that 70 percent of all program funds be granted for projects in jurisdictions having unemployment rates in excess of the national average. The remaining 30 percent of the funds are to be appropriated for projects in jurisdictions having unemployment rates equal to or below the national average. The vast majority of Bay Area communities qualifies to be considered for the 70 percent share of money.

Eligible projects include sanitary and storm sewer construction, but not wastewater treatment plants. Additionally, EDA funds can be used like HUD block grant money to provide the local share of money for constructing the collection facilities. Projects must be ready for construction within 90 days of the grant award.

Advantages

1. Because of local high unemployment rates, most jurisdictions in the Bay Area have been eligible to share 70 percent of the overall allocation.

2. The grant rate for funded projects can be 100%.

3. The program has been well funded - $2 billion nationwide through September 1977, $250 million of which is allocated to California. When grant recipients were published, the Bay Area's share was almost $46 million.

4. The purpose of the program is to funnel additional Federal money into local areas quickly, and thus applications have been evaluated in weeks and months, not years.

Disadvantages

1. The program has only been authorized through September 1977 and may not be extended to the future. For the present authorization, the deadline for submitting grant applications was December 6, 1976, and grantees have already been announced.

2. Grant requests in the Bay Area far exceeded the amount received.

3. Early application deadlines and quick project turnaround may mean that some projects might be too hastily developed and subject to inadequate review.

4. Wastewater treatment facilities, collection facility operation and maintenance are not eligible.

Funding and Budgetary Trends

Program funding in the amount of $2 billion was authorized for expenditure before September 30, 1977. Almost $46 million in projects were approved for the Bay Area, but only a small fraction will be used for wastewater facility construction. Because this is only a one-time program--so far, at least--there are no budgetary trends.

Examples of Use in the Bay Area

Funded projects were recently announced. Examples include a $1 million sewer relocation in the Napa Sanitation District and several smaller sewer projects in San Rafael, Corte Madera, San Leandro and Mountain View.

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5. GRANTS AND LOANS FOR PUBLIC WORKS AND DEVELOPMENT FACILITIES

Brief Description

The Public Works and Economic Development Act of 1965 authorizes a program of grants and loans for public works. This program is one of several administered by the Department of Commerce's Economic Development Administration, and was recently extended by legislation in 1976. The purpose of the program is to stimulate the economy in high unemployment areas by providing construction related jobs. The grant rate for funded projects is up to 50 percent of project cost, with provision for raising that amount to 80 percent in severely depressed areas. Loans are not common.

Sewer systems, but not treatment works, are eligible for funding. However, since creation of EPA and passage of the 1972 Amendments to the Federal Water Pollution Control Act, the policy of the Economic Development Administration has been to leave this responsibility to EPA. Therefore, EDA no longer funds sewer facilities under this program.

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6. FEDERAL FINANCING BANK LOAN GUARANTEES

Brief Description

Recent legislation passed by Congress and signed into law on October 20, 1976, authorizes the Environmental Protection Agency to guarantee loans made by the Federal Financing Bank to fund the

non-Federal share of constructing sewage treatment works. The program has not yet been set up, but is expected to work as follows. The Federal Financing Bank is authorized to make direct loans to local agencies to finance the non-Federal share of construction if certain conditions are met:

- o EPA must certify that the local agency is unable to secure a loan on the commercial lending market at "reasonable terms." The U.S. Department of Treasury will be responsible for determining the existence of "reasonable terms."

- o EPA must guarantee the loan by certifying that there is "reasonable assurance" that the local agency will repay it.

Advantages

1. Communities with credit problems that can not otherwise secure loans to provide the local share for wastewater treatment facilities may be able to use this program.

2. The rate of interest on loans will be lower than at commercial lending institutions.

3. Depending on how the Treasury Department defines "reasonable terms" and what the exact interest rate will be, the program could have widespread usefulness for many communities, whether or not they are suffering from credit problems.

Disadvantages

1. Very few--if any--communities in the Bay Area have attempted to finance the local share of constructing wastewater facilities by borrowing from commercial lending institutions. Wastewater agencies typically use bonds, property taxes and service charges for this purpose.

2. Money available for the Federal Financing Bank to loan will be subject to the Federal budgetary process. This is a very important aspect of the program. The absence of Federally budgeted money, for example, essentially killed the Environmental Financing Authority, a previous Federal program to assist local agencies in coming up with their share of construction funds.

3. EPA does not yet have the staff capabilities to process a loan program, and Federal regulations have not yet been issued.

4. After the program is underway, the evaluation of a community's credit-worthiness by EPA may cause minor delays in the construction of needed facilities.

Funding and Budgetary Trends

A budget for the loan guarantee program has not yet been approved. Because it is presently being set up, it is too early to know if the program will be useful in Bay Area jurisdictions.

Examples of Uses in the Bay Area

There are no examples yet.

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7. ENVIRONMENTAL FINANCING AUTHORITY

Brief Description

The Environmental Financing Act of 1972 established the Federal Environmental Financing Authority, which operated to assure that public bodies eligible for 75 percent Federal construction grants under the Section 201 program would be able to finance the local share if the agency were unable to sell its bonds on the normal bond market. However, authorization under this law ceased on July 1, 1975. Moreover, the Environmental Financing Authority was not given a sufficient budget to make its program highly visible. The program is no longer important, therefore, for financing environmental management.

8. FEDERAL REVENUE SHARING

Brief Description

For most wastewater treatment facilities, Federal and State grants will provide up to 87-1/2 % of the capital costs for construction. Construction of sewers, on the other hand, and operation and maintenance of all facilities are normally considered local responsibilities. Federal revenue sharing is one program that wastewater management agencies can use to bolster local money for these purposes.

Under the State and Local Fiscal Assistance Act of 1972, which was recently amended and extended into 1980, all state and general-purpose local governments are qualified to participate in Federal revenue sharing. State governments are entitled to one-third of all funds allocated to that state. The remaining two-thirds is divided among the local units of general-purpose government in accordance with a formula based on the local

property tax effort, population, and relative income of the governmental units. There is no obligation for the counties to distribute revenue sharing grant monies to special districts.

Disbursement of this money is allowed only for "priority expenditures." Municipal wastewater facilities are considered to have such priority. There is a provision in the law, however, that Federal revenue sharing money cannot be used to provide the local matching share for other Federal grants. Therefore, it cannot make up any part of the local 12-1/2% share for constructing treatment facilities because under normal funding circumstances this would be considered the local match of Federal "201" funds. Revenue sharing funds can be used, though, where other Federal money is not forthcoming--for constructing most sewers, for example, or for the operation and maintenance of treatment facilities.

Advantages

1. Revenue sharing money can be used where other Federal funds are not available.

2. If used for "priority expenditures," the money can be spent by local governments without prior project approval from the Federal government.

3. The program is well funded and will extend at least into 1980.

4. The amount allocated to a specific jurisdiction is fixed by formula and constant over the life of the program.

5. Money is automatically sent to local governments twice each year without an application process.

Disadvantages

1. In most instances, Federal revenue sharing funds will not be able to assist in the construction of wastewater treatment plants.

2. There is no direct funding of special districts, and many of the Bay Area's wastewater management agencies are special districts.

Funding and Budgetary Trends

The 1972 law included more than $30 billion for five years, or approximately $6 billion per year. The recent extension of the program raises this amount to $6.65 billion for Fiscal Year 1977-78, and $6.85 billion for each of the subsequent three years.

Examples of Use in the Bay Area

It is difficult to ascertain the specific uses that cities in the Bay Area are making with Federal revenue sharing money.

Recipients are required to file "Actual Use Reports" with the Federal Office of Revenue Sharing, but a displacement effect may operate so that other local funds are freed up. For example, if revenue sharing money is used for public safety, a portion of the police department's budget may become available for uses elsewhere. Therefore, examples can not be given with any degree of certainty.

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B. STATE SOURCES

1. STATE CLEAN WATER FUND GRANTS

Brief Description

California voters, pursuant to the Porter-Cologne Water Quality Act of 1970, authorized in 1970 and 1974 the sale of a total of $500 million in State Clean Water Bonds. These are general obligation bonds, secured by the State's general taxing power (its "full faith and credit"), and repaid from the general fund of the State. All State general obligation bonds enjoy a high level of marketability, and interest and overhead costs to the State are typically lower than for most other types of local and State bonds. As such, State Clean Water Bonds are considered an excellent financing technique.

Proceeds from the sale of bonds are used to finance the State's participation in planning, designing and constructing needed wastewater treatment facilities. Under the Porter-Cologne Act, the State will provide up to 12-1/2 percent of these costs. The fund is administered by the State Water Resources Control Board (SWRCB) in conjunction with the Federal "201" program. Together, State and Federal grants will cover as much as 87-1/2 percent of the eligible costs for wastewater treatment facilities, with the balance to be made up from local revenues. Collection facilities will typically be funded with State and Federal grant assistance to the extent that they alleviate designated health hazards.

SWRCB rules establish a priority ordering for grant applications so that the most serious water quality needs will have first access to the limited State and Federal grant money. The State board has also enacted regulations limiting the capacity of treatment facilities that is grant-eligible, and the degree to which the capacity used for treating industrial discharges can be funded.

Advantages

1. The State's potential 12-1/2% contribution on top of the maximum 75% Federal share means that the local burden may be only 12-1/2% of project costs.

2. As with Federal money, State Clean Water Fund grants are available for project planning, design and construction.

3. The priority ordering of projects means that those with greater beneficial impact on water quality will be funded first.

Disadvantages

1. Collection systems are fundable only to the extent that project absence presents a health hazard. In most cases, sewer construction is given such a low priority that it is rarely assisted with State Clean Water Fund grants and Federal "201" money.

2. The availability of State grants means that State regulations on plant sizing must be followed. Communities wishing to allow for more population growth than State projections indicate must finance additional capacity without State and Federal assistance.

3. State Clean Water Bonds have been passed twice since 1970, but another issuance may be needed in the next few years. This will require approval by two-thirds of the State's voters.

Funding and Budgetary Trends

California voters have twice approved bond sales of $250 million each. It is likely that a third bond election will be required in the next two years if State expenditures are to keep pace with Federal grant allocations. During Fiscal Year 1977, $65 million of the State Clean Water Fund will be disbursed to local applicants. Trends in State grants reflect the availability of Federal "201" funds, which are presently on the rise. Therefore, the State's expenditures in this regard are also increasing.

Examples of Use in the Bay Area

All projects making use of up to the 75 percent Federal "201" contribution also receive a maximum additional 12-1/2 percent from the State fund. There are dozens of examples throughout the region.

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2. STATE WATER QUALITY CONTROL FUND LOANS

Brief Description

The State Water Quality Control Fund is a relatively small amount of money from the State's general fund. It is used for loans to local agencies where extreme financial hardship prevents the construction of needed wastewater facilities. As authorized by the Porter-Cologne Act of 1970, loan funds are available for collection, treatment, disposal, and exportation facilities. A local agency interested in this source of money must demonstrate to the satisfaction of the State Water Resources Control Board that other sources are unavailable or are unreasonably expensive. For example, if an electorate has approved the sale of general obligation or revenue bonds by the local agency, the loan fund might be considered if the sale of these bonds were either impossible or so expensive that loans were an attractive financing alternative to cover the local share.

The current interest rate for these loans is 5.3 percent, and applicants are usually granted a 10-year grace period before repayment begins. The availability of funds depends on the funding for the fiscal year, the competitiveness of a given application, and assurances by a community that the loan can and will be repaid. Special consideration is given to projects in areas where the state or local health department has declared a health hazard.

Advantages

1. Communities that are financially hard pressed to generate their local share for wastewater facilities or where there is a health hazard that can be alleviated are given a competitive advantage for this limited source of funds.

2. Loan funds may be used for the capital costs for all wastewater facilities.

3. A 10-year moratorium on payback is readily available.

Disadvantages

1. Loan funds are very limited.

2. Most communities are disqualified from receiving this funding because they are unable to demonstrate extreme financial hardship.

3. Loan funds can only be disbursed on a showing by the community that there is reasonable assurance of repayment. If voters reject the special assessments or tax increases, for example, that will be used to repay the loans, SWRCB will not approve the loan.

Funding and Budgetary Trends

The funding for this program has been and continues to remain at a low level. As a revolving fund, the availability of these monies depends to a great extent on repayment of past loans. Payback moratoria are easily secured, and when the program was first authorized in 1949, the interest rate on loans was 2%. Because of this and low appropriations in recent years, there is a very limited amount available for further loans. For fiscal year 1976-77, SWRCB's budget contains $535,300 for this program.

Examples of Use in the Bay Area

The Stinson Beach County Water District's proposal for sewage collection and treatment facilities included State loan funds from this source as part of the financing package. SWRCB was ready to disburse the funds, but voters in the district rejected the proposal for increased taxes to repay the loans.

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C. LOCAL SOURCES

1. LOCAL GENERAL OBLIGATION BONDS

Brief Description

General obligation bonds are used commonly by local wastewater authorities--both general and special purpose governments--to finance the local share for construction of wastewater collection and treatment systems. For treatment facilities and major interceptors, the share is usually 12-1/2%, but for most collection lines it will more likely be 100%.

Secured by the "full faith and credit" of the issuing agency, local general obligation bonds are issuable only by municipalities and special districts possessing ad valorem property taxation power. Default can be averted through recourse to the taxing power, although this is not usually necessary. General obligation bonds can be repaid by revenues from any source, and this allows a certain degree of flexibility in designing financing programs.

In most cases, the issuance of such bonds is statutorily limited to a percentage of the total assessed valuation in the jurisdiction. For cities and counties, the limit is 15 percent. In some special districts there is no limit, but in others it will

range from 10 to 20 percent depending on the type of district. However, more stringent practical limits prevent an agency from issuing bonds to the extent that its credit rating might be impaired.

Advantages

1. Because general obligation bonds are secured by an agency's taxing power, they are attractive to investors and can generally be sold at a lower interest rate than other types of debt instruments issued by the same agency.

2. The application and issuing process is less complicated than for other bonding methods.

3. Several projects undertaken by the same authority can be financed through the same bond issuance.

4. The interest accruing to investors is tax exempt, making the bonds relatively easy to market.

Disadvantages

1. State law requires that issuance of local general obligation bonds receive approval by two-thirds of the voters for issuance.

2. General obligation bonds are more desirable to voters when project revenues instead of the agency's taxing power can be used for repayment. If project revenues are uncertain, therefore, a ballot measure is less likely to be approved.

3. In communities with already high tax rates, general obligation bond issues can be difficult to pass.

Funding and Budgetary Trends

The issuance of general obligation bonds is one of the most common techniques in the Bay Area for financing the local share of wastewater collection and treatment systems. Bond approval by an electorate is not automatic, but can be expected if past and present trends continue. San Francisco voters, for example, passed an issue in November of 1976 to help finance the city's $1 billion wastewater program.

Examples of Use in the Bay Area

San Francisco is expecting to use previously and recently authorized general obligation bonds to finance the local share of the city's massive wastewater collection and treatment system. As an example of a special district, the East Bay Municipal Utility District, a special purpose government having taxing authority, has also used general obligation bond revenues for a number of its capital improvements; one example is the addition of secondary treatment to its plant in Oakland.

Contact Person

In general, further information should be available from the financing managers of jurisdictions where such bonds have been issued, bond attorneys, and bank officers.

2. REVENUE BONDS

Brief Description

Revenue bonds are often used to finance the local share of constructing wastewater collection and treatment facilities, but are not as common in the Bay Area as general obligation bonds. Most revenue bonds used for wastewater facility purposes are authorized under the State's Revenue Bond Law of 1941. Under this statute, any local agency can market such bonds if they are approved by a majority of the voters in the jurisdiction.

An emergency provision in the law provides that revenue bonds can be issued in extreme cases without voter approval. One such extreme case occurs when a Regional Water Quality Control Board has issued a cease and desist order to a discharger. If the State Water Resources Control Board agrees with the order, revenue bonds can be sold without voter approval if proceeds will alleviate the situation.

The formation of a non-profit corporation can result in the issuance of revenue bonds without voter approval. This institutional technique has had limited usefulness in the Bay Area.

Joint powers agencies--the East Bay Dischargers Authority and the South Bay Dischargers Authority, as examples--are authorized to issue revenue bonds for wastewater facilities. Bonds must be approved by a majority of voters within each jurisdiction signing the joint exercise of powers agreement, and then the agency administering the agreement can issue the bonds.

Under the 1941 law, revenue bonds are repaid with service charges from the facilities constructed with bond proceeds. Unlike general obligation bonds, there is no recourse to money derived from ad valorem property taxes or special assessments. Revenue bond marketability depends on an evaluation by potential buyers of the reliability of the revenues pledged for bond repayment. Therefore, revenue bonds are best used to finance wastewater facilities in jurisdictions where there is a substantial service base from which adequate revenues can be generated.

There are no legal limitations on a jurisdiction's bonded debt from the issuance of revenue bonds, as there are for general obligation bonds. However, there are practical limits, and excessive offerings by an agency may indicate that bonds are a high investment risk.

Advantages

1. Revenue bonds are repaid with project revenues, meaning that the ad valorem tax rate can not be affected.

2. By State law, they require only majority approval instead of two-thirds, and there is an emergency provision for issuing revenue bonds without voter approval. Majority approval in joint powers agencies, however, means ratification by each jurisdiction which is party to the agreement.

3. There are no legal debt limits for revenue bonds.

4. For a joint powers agency, revenues from a larger district will be pledged, and thus marketability may be affected positively.

Disadvantages

1. The bond market considers that project revenues are less secure than the taxing power. Revenue bonds thus carry higher interest rates than general obligation bonds. The interest rate differential typically ranges up from 1/4 percent, or at least $2,500 per year on a $1 million issuance.

2. Revenue bonds require more exact planning and management so that an adequate stream of revenues can be assured.

3. Bond issuance is quite complex because the issuing agency must execute a series of formal documents which describe and secure the revenue pledge. Joint powers agency revenue bonds require in addition that an acceptable joint exercise of powers agreement be executed.

4. Smaller communities, where the service base is more limited, will have a reduced ability to market revenue bonds.

Funding and Budgetary Trends

In the absence of a joint powers agreement, financing the local share of construction costs for wastewater facilities is more often done through general obligation bonds than revenue bonds. Although issuance approval requires only a simple voter majority, officials appear to prefer general obligation bonds because of their greater degree of repayment flexibility, lesser cost, and ease of issue. Joint powers agencies, on the other hand, are more likely than single jurisdictions to prefer revenue bonds because one issuance can cover all parties to the agreement.

Examples of Use in the Bay Area

The Union Sanitary District has used revenue bonds to finance its share of the upgrading of East Bay Dischargers Authority treatment

facilities. There are only a few such issuances by single jurisdictions. A joint powers agreement revenue bond issue was turned down by voters in the Livermore-Amador Valley, although bonds could be issued without voter ratification under the emergency provision described above. A non-profit corporation formed in Concord was able to issue revenue bonds without voter approval in order to finance the local share of an interceptor.

Contact Person

Municipal finance officials, bond attorneys and bank officers would be the best sources for more information.

3. SPECIAL ASSESSMENT BONDS AND SPECIAL ASSESSMENTS

Brief Description

Capital improvements benefiting a limited geographical area are often financed by special assessment bonds. Agencies commonly use this technique to build collection sewers. Use of this financing mechanism involves the creation of a special assessment district of properties that will benefit directly or indirectly from the capital improvements. Typically, a city or county will initiate the proceedings to create an assessment district within its boundaries by having a project report prepared and holding a public hearing. In some cases the proceedings can be stopped if owners of a majority of affected lands file written protest of the assessments proposed in the project report. Proceedings can not be stopped by local property owners if the proposed facilities have been classified by the county health officer as a necessary health measure. If the district is created, costs of the improvements will be apportioned among the properties and will be based on the measure of relative benefit.

Most special assessment bonds are repaid only from the assessment charges collected from affected properties. Unpaid assessments become a lien on these properties. Typically, there is no claim to general tax revenues, but state law does include an emergency provision if assessments are not collected. The agency in this instance can levy up to $.10/$100 per year tax rate so that default can be avoided.

Because of the limited ability to fall back on taxes, assessment bonds are considered a slightly greater investment risk than general obligation bonds, which are backed up by the "full faith and credit" of the issuing agency. Also, as described above, the issuance procedure is rather lengthy and complicated. Therefore, assessment bonds are a relatively expensive way to finance capital improvements.

Advantages

1. Assessment bonds are backed by assessments on the properties affected, and thus the project does not require a steady stream of user charges and will not usually affect the property tax rate.

2. Because costs of improvements are related directly to the benefits received by properties in the assessment district, responsibility can be fairly distributed among property owners.

Disadvantages

1. Because of the nature of an assessment district and the assessments, these bonds are much more practical for financing the local share of collection sewers (usually 100%) rather than the local share of treatment plants.

2. Both the establishment of an assessment district and the issuance process are relatively complicated and expensive.

3. Repayment of assessment bonds is tied only to direct assessments on affected property, with an emergency provision for limited property tax backup. Because of this, the market places a relatively high interest rate on such bonds.

Funding and Budgetary Trends

Assessment bonds are best used for constructing collection systems and do not have widespread usefulness in large urban areas that are already sewered. Whenever they are proposed, though, it is uncommon for property owners to object to their use.

Examples of Use in the Bay Area

Bodega Bay is one of the few examples in the Bay Area where the assessment bond technique has been used to finance treatment plant construction. There are dozens of examples of such use for sewers.

Contact Person

Municipal finance officials, bond attorneys and bankers are the best sources.

4. IMPROVEMENT DISTRICT BONDS

Brief Description

Improvement districts can be formed in the subarea of many types of special districts, among them county sanitation districts, community services districts, municipal improvement

districts, and public utility districts. In certain of these districts, general obligation bonds can be issued only for the improvement district area. Issuance of these bonds, as for any general obligation bonds, requires approval by two-thirds of the improvement district voters. The bonds are identical to other general obligation issuances, with the following exceptions:

- Only property taxes can be used for bond repayment; there is no claim, for example, on project revenues.

- Because the bonds are tied only to property taxes, marketability is typically a function of total assessed valuation in the improvement district.

- Interest rates are somewhat higher than for other general obligation bonds.

Funding and Budgetary Trends

This is not a common financing technique for wastewater faciliti€

Examples of Use in the Bay Area

No current examples are known in the Bay Area.

Contact Person

Special district finance officers, bond attorneys and bankers are the best general contacts.

5. PROMISSORY NOTES FOR SHORT TERM DEBT

Brief Description

Short term borrowing on the private capital market is a common financing mechanism used by local agencies. All local agencies can issue tax anticipation notes, for example, under State Senate Bill 90 passed in 1972. The amount of principal that can be borrowed is limited to 85 percent of the anticipated tax revenues, and the notes must be retired before the end of the fiscal year in which they were issued.

Most local jurisdictions can also issue other short- and medium-term notes. These notes will mature in two to ten years, and voter approval is not required. There are limitations on the issuance of such notes, and the law varies for cities, counties, and different types of special districts. Typically, the enabling leg'slation will limit the amount of principal that can be borrowed, the term of the debt, and the maximum interest rate

Advantages

1. Tax anticipation and other short-term notes are useful in helping an agency meet its immediate cash-flow problems. Facility operation and maintenance are possible uses of such money, but only for the short-term.

Disadvantages

1. Because of the limitations imposed by law, this type of debt is not useful for financing the construction of capital facilities.

Funding and Budgetary Trends

The function of these financing devices is to cover short-term cash-flow problems. As such, they are largely emergency measures.

Examples of Use in the Bay Area

There are many examples where promissory notes have been used for short-term revenue purposes, but their application to wastewater facilities is not known.

Contact Person

Bank officials and municipal finance officers would be the best sources.

6. PAY-AS-YOU-GO FINANCING

Brief Description

"Pay-as-you-go" financing is the term that describes the use of cash reserves to pay for capital improvements. It is often used when capital needs are relatively light and the agency has a surplus of money. This surplus can be accumulated if the agency receives higher than necessary revenues from property taxes, service charges, connection charges, and any other sources.

Advantages

1. There are no debt limitations for agencies to be concerned with, and elections, as for bond issues, are unnecessary.

2. There are no borrowing costs.

Disadvantages

1. This financing technique requires meticulous long-term capital planning so that sufficient reserves can be accumulated.

2. If reserves must be available in advance, it is likely that this technique would be useful only for relatively small capital projects.

3. To accumulate reserves, the agency will likely need to set the property tax rate at a level higher then absolutely necessary. This may prove to be politically difficult.

4. Because of current high inflation rates, "pay-as-you-go" may be less attractive financing than issuance of general obligation or revenue bonds.

<u>Funding and Budgetary Trends</u>

This technique has been used extensively in the Bay Area for financing construction and maintenance of sewers. It has also been used for certain wastewater treatment improvements.

<u>Examples of Use in the Bay Area</u>

Most local participants in the South Bay Dischargers Authority used cash reserves to finance the local share of their interceptor outfall. The local share of wastewater reclamation projects in the Bay Area is often financed by cash reserves. Many other examples could be cited.

<u>Contact Person</u>

The best contacts for further information would be the finance or budget officers of local jurisdictions.

7. AD VALOREM PROPERTY TAXES

<u>Brief Description</u>

Ad valorem property taxes have long been part of the financing package for constructing local sewer systems and for providing the local share of constructing wastewater treatment facilities. Recent rulings by the U. S. Attorney General, however, prevent local governments from using property taxes to cover operation and maintenance costs for wastewater facilities subsidized with Federal funds. Moreover, certain types of special districts (community services districts and sanitary districts, for example) operate under absolute rate limits as a percentage of the assessed value, and increases beyond these limits can be made only with voter approval.

Property taxes are typically tied to other financing mechanisms. For example, they are used for repayment of general obligation bonds and tax anticipation notes. They often supply the cash reserves needed for "pay-as-you-go" financing.

The general use of property taxes is now restricted in California. State legislation passed in 1972--Senate Bill 90 as amended by Assembly Bill 2008--requires approval by voters in local jurisdictions for any increase in the property tax rate which would make it greater than that in effect during either fiscal year 1971-72 or 1972-73. There are several exceptions to this rule, particularly for areas of rapid population growth. There is also some question about whether voter approval is required if property tax increases are needed to construct State and Federally mandated wastewater facilities.

Advantages

1. Property taxes for wastewater facilities are easy to administer because they are flexible and local governments have long experience with them.

2. Property taxes can be levied on undeveloped properties that benefit from the availability of reserve wastewater capacity, although this practice may encourage unwanted development.

Disadvantages

1. Unlike service charges, property taxes are not connected in any direct way with the generation of wastes.

2. Property taxes cannot be used for system operation and maintenance where Federal money has assisted in construction.

3. Use of property taxes for construction or operation and maintenance of wastewater facilities has been put in question by recent state legislation.

4. Certain types of special districts have absolute limits on the rate of property taxes as expressed by a percent of assessed valuation.

Funding and Budgetary Trends

Property taxes are usually tied to other financing mechanisms. Their use, therefore, is a function of the degree to which general obligation bonds, tax anticipation notes, and "pay-as-you-go" financing, for example, are employed. The 1972 State legislation and recent Attorney General opinions will limit the flexibility of using property taxes in future applications to wastewater systems.

Examples of Use in the Bay Area

All general obligation bond issues, such as the one approved in San Francisco in November of 1976, are backed by property taxes. All communities using "pay-as-you-go" have accumulated their cash reserves at least partly through property taxes.

Contact Person

The finance or budget officers of local governments would be able to supply more information on property taxes.

8. SERVICE CHARGES

Brief Description

Service (or user) charges are very commonly imposed by wastewater management agencies in the Bay Area. Revenues from the charges are used to operate and maintain the collection and treatment facilities. Less often they cover debt service and the financing of capital items.

Service charges can be gauged in several ways, but they must reflect system use in some manner. Charges are often tied to either the consumption of water or the volume of discharge; these require that the flow be metered. Alternatively, flat charges per dwelling unit or water-using fixture can be imposed.

A metered rate would seem to provide incentives to customers to reduce water and sewer use. Pricing policies could also be established to discourage excessive use of facilities. However, the effect of metered rates and pricing policies on residential and commercial uses has been found to be rather small. On the other hand, industrial water and sewer uses are known to be sensitive to such practices. Therefore, service charges tied to flow are more meaningful to industrial than residential or commercial uses.

Advantages

1. All municipalities and special districts involved in wastewater management have the authority to levy service charges.

2. Service charges can be used for both capital and revenue formation, although they are much more commonly used for revenue.

3. There are several ways to gauge user charges, a feature which allows some flexibility in designing a revenue program. Those methods based on metered flow and pricing policies to discourage excessive use can potentially provide incentives to users to limit water intake and discharge.

Disadvantages

1. Service charges based on measured volume of water consumed or discharged do not take into account benefits to properties that have the service available but for some reason are not taking full advantage of it. Nor do they account for infiltration contributions from undeveloped parcels.

Funding and Budgetary Trends

Service charges to customers of wastewater agencies in the Bay Area are very common, though not universal. The money collected is most often used for system operation and maintenance. As operation and maintenance costs rise, service charges are bound to rise proportionately.

Examples of Use in the Bay Area

Almost all Bay Area wastewater agencies use service charges in one form or another to cover system operation and maintenance, although they vary in the method that ties them to actual facility use. One unusual use of service charges has been made by Vacaville, which raised them and collected enough money to avoid having to issue bonds to finance the local share of constructing treatment facilities.

Contact Person

Finance officers of the Bay Area's wastewater management agencies should be contacted.

9. CONNECTION CHARGES

Brief Description

A connection charge is usually imposed on a new user of wastewater facilities. New users can be either new or previously existing development. Although the charge is levied when hookup with a sanitary sewer system is made, it is intended to assure that the capital cost of previously existing treatment facilities is borne by those who later benefit. Connection charges are particularly important for rapidly growing communities where a sizable portion of treatment capacity is held in reserve for future development.

The typical connection charge for dwelling units in the Bay Area ranges from a nominal amount (or nothing) to more than one thousand dollars per unit. Charges on industries and commercial enterprises are usually developed individually and based on detailed engineering analyses of system use. Connection charges are escalating quite rapidly and in many cases are directly related to an index of construction costs.

Advantages

1. Ideally, connection charges are set at levels that ensure that new users pay their fair share for existing capital facilities.

Disadvantages

1. If growth does not take place as forecast, connection charges may not generate adequate revenues to cover costs. Wastewater management agencies in these areas may need to fall back on property taxes or other financing mechanisms.

2. Connection charges for commercial and industrial dischargers need to be determined individually on the basis of detailed engineering reports.

Funding and Budgetary Trends

Almost all municipal wastewater agencies in the Bay Area use connection charges. As noted above, they vary widely from jurisdiction to jurisdiction. Moreover, connection charges in some areas are rising quickly so that the cost involved in financing present treatment capacity for future users can be offset.

Examples of Use in the Bay Area

The City of Oakland does not charge a connection fee for a new dwelling unit to tie into its sanitary sewer system, but it does have a $60 "permit charge" for this purpose. The connection charge imposed by Livermore for a single family residence during 1975 was $1229.

Contact Person

Officials in wastewater collection and treatment agencies would be able to supply more information on this subject.

10. STANDBY CHARGES

Brief Description

Standby charges are charges made on unimproved properties where wastewater service is available but unused. One theory behind standby charges is that the land, although undeveloped and not physically tied into the wastewater system, is more valuable because of service availability. Another theory is that the land may be contributing to any system infiltration/inflow problems. Any management agency imposing such charges tacitly guarantees that treatment plant capacity is reserved for this land.

Standby charges are usually billed annually or monthly. They are typically based either on some reasonable allocation of debt service among developed and undeveloped parcels within a certain distance from existing sewer lines or on the degree to which an unimproved lot is contributing to any infiltration/inflow problem. In all cases, such charges should be significantly lower than normal service charges to facility users.

Advantages

1. It is reasonable to expect that a property owner might pay for the future availability of sewer service and treatment capacity.

2. Such charges are not currently widespread and could provide a new source of revenue for management agencies.

Disadvantages

1. Standby charges may encourage unwanted development because they make it more costly to hold onto undeveloped land.

Funding and Budgetary Trends

The technique has never been used in the Bay Area, but it is legal and may receive increased attention as a new source of revenue.

Examples of Use in the Bay Area

There are none as of yet. One recent proposal for the Tahoe-Truckee Sanitation District would have enacted a $10 per year standby charge on undeveloped properties within 100 feet of a sewer line. The concept was abandoned, however, because the treatment plant was close to capacity and future service could not be guaranteed.

Contact Person

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San Francisco, CA 94104
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11. INDUSTRIAL COST RECOVERY

Brief Description

The Division of Water Quality within the State Water Resources Control Board administers a set of "Revenue Program Guidelines" pursuant to Federal and State law. These guidelines assist local wastewater agencies to develop and implement revenue programs so that users of their facilities can be charged appropriately and consistently for services rendered.

One Revenue Program aspect not covered elsewhere in this paper concerns "industrial cost recovery," which is required under Federal law and regulations. Many industries discharge wastewater into a municipal system instead of directly into a receiving body of water. If treatment plant capacity must be

enlarged to accommodate an industrial user, all such costs must be repaid by that industry. Furthermore, if an industrial discharge into a wastewater facility requires treatment further than that for normal municipal flow, the industry must also pay these costs. The intent of the Revenue Program Guidelines is to prevent a Federal subsidy for the planning, design, and construction of wastewater facilities that are allocable to industrial users. On the other hand, there is no requirement for industrial cost recovery of the State's maximum 12-1/2 percent share of such costs.

Contact Person

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CONCLUSION

The purpose of this paper has been to list and describe Federal, State and local programs that can provide money to local wastewater management agencies in the San Francisco Bay Area. Both capital and revenue sources have been discussed. The use of the money for facility construction and/or operation and maintenance has also been noted.

The construction of all wastewater treatment facilities in the Bay Area is assisted by Federal and State grants. Disposal facilities and interceptors can also be subsidized. The "201" program provides up to 75% of the capital costs for construction, and all treatment facilities currently being built in the nine counties make substantial use of this money. Proposals do not always receive the full 75 percent because an occasional item will not be grant-eligible, but awards are normally very close to the maximum. Similarly, State Clean Water Fund grants provide up to 12-1/2% on top of the maximum 75 percent Federal contribution. For the local share of construction costs for treatment, most agencies will use general obligation bonds, revenue bonds, or pay-as-you-go financing--either alone or in combination.

Collection sewer construction is financed differently. "201" assistance and State Clean Water Fund grants will generally not be available unless the lack of proper sewer facilities has created a health hazard. There are a number of other Federal and State programs described in this paper that will fund some sewer projects, but sewers are generally considered a local responsibility. Therefore, construction of collection facilities is most often accomplished through recourse to the various bonding techniques and special assessments.

System operation and maintenance is also thought to be a locally funded task. Federal revenue sharing is the only non-local program which can be used to cover these costs. Because local property taxes can not be used for operation and maintenance, the most common financing mechanisms used for this purpose are service charges and connection charges.

It is not known whether "201" and State Clean Water Funds will continue at the same or increased levels in the future. Obviously, determinations of this sort will affect facility implementation to a major degree. The "201" budget has been on the rise for the last several years, but it is subject to annual Congressional approval. It would not surprise most observers if the level of funding begins to decrease in the next three or four years. The State has almost exhausted the proceeds from a second $250 million bond authorization, and voters will need to approve a third issue within the next two years so that the funding pace can be maintained.

Now that billions of dollars have been spent by the Federal and State governments to subsidize local wastewater management, U. S. Congress and the California Legislature may decide that the construction of future wastewater facilities can be financed to a much larger degree by local programs. Policy shifts of this sort are inevitable and will pose important problems to local agencies. It is not too early for local government officials to begin thinking of methods to deal with these issues.

WQ/Tech Memo 10/ 2-25-77
B. Fitting

WATER QUALITY MANAGEMENT PLANS

PUBLIC FINANCING OF INDUSTRIAL WASTEWATER ABATEMENT

TECHNICAL MEMORANDUM NO. 10

FEBRUARY 25, 1977

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INTRODUCTION (EXECUTIVE SUMMARY)

Industrial water pollution control facilities are paid for mostly through private capital financing. Money thus spent by a firm is typically recouped by price hikes on the goods and services of that company. However, some public financing does exist.

The purpose of this paper is to list, describe and review public programs currently available which can assist private industry in the financing of its water pollution cleanup. There is only a relatively small handful of such programs, and they are mostly at the Federal and State levels of government.

Most of these programs will help in financing or subsidizing the capital facilities necessary for abatement. None will assist in the operation and maintenance of pollution control equipment. Most programs are available both to industries which pretreat their effluent for discharge into a municipal plant and to those that discharge directly into a receiving water.

PUBLIC FINANCING PROGRAMS

A. FEDERAL PROGRAMS

1. WATER POLLUTION CONTROL LOANS

The Small Business Administration (SBA) conducts a program of making loans to small businesses likely to suffer economic injury as a result of having to comply with Federal water pollution control requirements. The program is authorized by the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, which served in part to amend the Small Business Act.

According to the Small Business Act, a "small business" concern is one that is independently owned and operated, and one that is not dominant in its field of operation. The SBA Administrator makes the specific determination of what is and is not a small business in a given industrial category.

The law does not limit the amount of loan funds available to a single company, but unless substantial hardship can be proven, the maximum loan will not exceed $500,000. The SBA prefers, however, to guarantee loans from private lending institutions rather than to make direct loans, although it does both.

For guaranteed loans, interest rates are set by the lending bank but must fall within limits set by SBA. On direct loans by SBA, the interest rate for a 30-year loan has been set at 6 5/8 percent.

Loan funds can be used for a variety of purposes related to compliance with provisions of the Federal Water Pollution Control Act. Eligible activities include construction of pretreatment facilities and interceptor systems for plants discharging to municipal facilities, additions or modifications to existing facilities, and changes in methods of operation. The Environmental Protection Agency must certify that the funded facilities are required in order to comply with pollution control requirements.

2. SMALL BUSINESS POLLUTION CONTROL BOND GUARANTEES

Public Law 94-305, passed by the U.S. Congress and signed into law in 1976, sets up a new program empowering the Small Business Administration (SBA) to provide 100 percent guarantees for pollution control bonds. These are tax-free state and municipal industrial revenue bonds sold to finance pollution abatement equipment for small businesses. In California the program is limited to State bond guarantees because local agencies cannot issue such bonds under current interpretations of the California Constitution.

Eligibility criteria and size standards governing small businesses have been established by SBA. Annual revenues of an applicant cannot exceed $9,000,000, the applicant's maximum net worth cannot exceed $4,000,000, and the annual net income after taxes for the previous two years cannot be more than $400,000.

The purpose of the legislation, according to its proponents, is to give these business access to capital markets on an equal footing with larger firms. Small businesses have historically been unable to sell industrial revenue bonds on the public market because such companies are unknown to investors and the amount of capital required is too small to warrant the expense of a bond issue. The new program seeks to group these bonds into larger packages and provide guarantees by SBA--two measures which should make them more attractive to investors. As a result, small businesses should enjoy new sources of long-term investment capital for pollution control, lower interest rates, longer payment terms and simplified documentation.

The act does not limit the amount that SBA may guarantee, although the Bank of America has forecast that the program could provide $2.2 billion over its first five years. Moreover, the law does not require that the facility for which bonds have been guaranteed be used exclusively for control of pollution. The statute authorizes $15 million to provide capital for start-up of the program.

The California Pollution Control Financing Authority (CPCFA), described more fully below, has recently been selected by SBA to conduct a pilot program using the bond guarantees. CPCFA has called for applications to be submitted by eligible small businesses. An applicant must have a sponsoring bank certify to CPCFA and SBA that the firm is creditworthy and at a financing disadvantage in the open bond market. Applications are now being accepted by CPCFA for new projects not yet under construction.

3. TAX LAW SUBSIDIES

Federal taxation law allows private enterprise several tax advantages not available to public agencies. Tax incentives act as public subsidies to assist industries in financing wastewater pollution abatement.

One advantage is in the depreciation of capital facilities, which private industries can deduct from income. To the extent that depreciation deductions allowable by the Internal Revenue Service exceed the real loss in value of the depreciated property, this represents a tax "loan" for as many years as it takes the real depreciation to reach the accounting loss in value.

A refinement of the above subsidy more applicable to pollution control facilities is authorized by the Federal Water Pollution Control Act Amendments of 1972 and incorporated into Section 169 of the Internal Revenue Code. Under this authority, private industry can take acceleration depreciation (also known as "rapid amortization") of wastewater control facilities. The law allows amortization of eligible items over the term of five years, with an additional 20 percent depreciation deductible during the first year. The tax "loan" for pollution control facilities is therefore quite substantial. The only limitation is that the industrial plant must have been in existence prior to 1969.

Other than deductions from income, private industry is also allowed an investment tax credit. Any commercial or industrial enterprise can take

a maximum tax credit of seven percent of its expenses for investment in tangible personal property with a useful life of at least seven years. The percentage declines as useful life of property drops down from seven to three years. To qualify for this credit, the property must be depreciable, have a minimum useful life of three years, be an integral part of the firm's operations, and be put into service during the year in which the credit is taken. The total credit allowed may not exceed the total tax liability of any one year, but should there be unused credit, it can be carried over to future years.

B. STATE PROGRAM

1. CALIFORNIA POLLUTION CONTROL FINANCING AUTHORITY

The California Pollution Control Financing Authority (CPCFA) was created in 1973 to assist the State's industries in the financing of required pollution control facilities. All private firms that need to comply with Federal, State or local water pollution control laws and regulations are eligible for assistance in this program. CPCFA sells bonds to finance the building or installation of industrial wastewater treatment facilities.

The involvement of the State allows the interest on these bonds to be exempt from Federal and State income tax. As a result, they can be issued for lower interest rates than on conventional loans. CPCFA has estimated that its bonds can help private enterprise to finance pollution abatement equipment at 2% to 5% lower in annual interest rates.

The State does not pledge its own credit for repayment. Security for a bond issuance is primarily the credit of the firm for which the project is being financed. CPCFA basically acts as the vehicle to provide tax exemption.

One result of this situation is that smaller companies have been much less likely to receive assistance from CPCFA. Investors may demand high interest rates on bonds used to finance projects for firms that are not as well known, and the capital required by a smaller company often does not justify the expense of a bond issuance. These problems have been dealt with by recent Federal legislation (described above in this paper) providing for loan guarantees by the Small Business Administration. CPCFA is now working with SBA to establish a pilot program of loan guarantees for smaller firms that would not have recourse to CPCFA's programs without such guarantees.

To be eligible for financing assistance, pollution control equipment must be certified by the State Water Resources Control Board as necessary to meet environmental standards. Facilities must comply with an Internal Revenue Service requirement that they do not generate a material profit for the operator. CPCFA rates projects in a manner that favors those for which cleanup deadlines have already been established. When there are not enough funds for all eligible requests, there is a further priority categorization giving an advantage to less expensive projects.

CPCFA operates under a program limitation preventing the authority from approving more than $50 million in bonds during any one calendar year.

In 1972, California voters authorized the issuance of $200 million in bonds, the proceeds of which will soon be exhausted. An extensive backlog may have to await the authorization of another issuance.

C. LOCAL PROGRAM

1. LOCAL INDUSTRIAL REVENUE BONDS

Industrial revenue bonds in many states can be authorized and issued locally. Local agencies can in this manner assist in the financing of private capital facilities. Tax exemption of interest allows bonds to be issued at relatively low interest rates, thereby providing an advantage to industry. Another advantage is that projects do not have to compete with others statewide for acceptance by local bond-issuing authorities.

This financing technique, however, appears to be inconsistent with the California constitution. Recent rulings have led to the conclusion that issuance of such bonds is not a legal use of public credit, and thus industrial revenues bonds are not currently issued by local authorities in California.

CONCLUSION

Public subsidies for private industrial wastewater abatement are limited in number. Virtually all firms will take advantage of existing tax breaks, but the other programs are a bit more specific in which facilities they favor. The two SBA programs, of course, pertain to smaller firms, whereas the CPCFA until recently has been more important to the larger.

Programs favoring small businesses are likely to increase in importance now that SBA has money for its loan program and Congress has authorized bond guarantees. CPCFA, on the other hand, will be much more limited in its future ability to assist the implementation of industrial abatement facilities unless further issuance of bonds is soon authorized.

WQ/Tech Memo 13/April 77
B. Maddaus

WATER QUALITY MANAGEMENT PLANS

PRELIMINARY RECLAIMED WASTEWATER MARKET SURVEY

TECHNICAL MEMORANDUM No. 13
APRIL 4, 1977

This memorandum summarizes the preliminary results of the reclaimed wastewater market survey. The ABAG 208 Study Area was divided into five subregions:

1. Peninsula - San Mateo County and San Francisco
2. South Bay - Santa Clara County
3. East Bay - Alameda and Contra Costa counties
4. Napa-Solano - Napa and Solano counties
5. Marin-Sonoma - Marin and Sonoma counties

The first table is a summary of the reuse by subregion on an average daily basis. A comparison with the available wastewater supply indicates that about 103 mgd or 19 percent of wastewater will be reused by 1990.

Each subregion was subdivided into a number of subareas to provide sufficient detail in identifying potential reuse markets. The annual quantities (in million gallons and million liters) shown for the various categories of reuse were taken from published reports. Approximately 50 wastewater treatment facility plans, environmental impact reports, and separate reclamation studies were reviewed. References for the information are listed at the bottom of each sheet. It appears that nearly all local potential markets have been considered at one time or another in published reports.

The reuse projection was developed as follows: If a certain reuse project was in the facility planning stage, it was assumed that the project would be on-line by 1980. However, if the project appeared feasible but had institutional, financial, or other details to be worked out, or if facility planning had not yet begun, it was assumed that the project would not be on-line until 1985. If a certain reuse project was in the "thinking" stage but appeared to be feasible, that is, it had no major public health or other problems, it was assumed to be on-line by 1990. In this was the cumulative totals of reuse projected to be on-line in each subarea in 1980, 1985, and 1990 were developed.

Naturally some of these projects may fail to be implemented for some unknown reason and other new projects may be developed and implemented, however, this projection is probably the best available estimate of the amount of reuse that will occur in the Bay Area. Major technological breakthroughs, a change in the public health standards, prolonged water shortages, wastewater transfers between subregions or export out of the Bay Area are factors which have not been considered and could lead to an increase in future reuse.

April 4, 1977

SUMMARY OF RECLAIMED WASTEWATER MARKETS
(average annual mgd)

Planning Area	Existing Reuse[a]	1985 Wastewater Supply[a]	1985 Planned Reuse	1985 Percent Utilization
Peninsula (San Mateo, S.F. Co.'s)	3.0	150	15	10
South Bay (Santa Clara Co.)	3.4	140	10	7
East Bay (Alameda, Contra Costa Co's.)	4.0	196	51	26
Napa-Solano	0.3	30	19	64
Marin-Sonoma	1.0	30	8	26
TOTAL	11.7	546	103	19

[a]Source: San Francisco Bay Basin Water Quality Control Plan includes municipal sources only.

EAST BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

ALL SUBAREAS COMBINED

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture		1000	3800			1000	3800	1450	5500	2360	7800
Landscape		130	500			130	500	1085	4110	1185	4490
Open Space											
Marsh Enhancement											
Rec. Lake								540	2020	540	2020
Industrial:											
Cooling						5480	20700	9570	36200	9570	36200
Process						5480	20700	5480	20700	5480	20700
Other											
Combined								180	680	180	680
Commercial											
Fire Protection											
Construction											
Other		365	1380			730	2760	730	2760	730	2760
TOTAL		1495	5680			12820	48460	19125	71970	20045	74650
Scope of Study											
Project Status											
Implementation Problems:											
Public Health											
Financial											
Lack of Demand											
Institutional											
Other											
References:											

EAST BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

NORTHERN BAY SHORE CITIES SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape				12.2[3]	<(27-1.22)			560[1]	2130	560	2130
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling				1.9[3]	22-46			4090[2]	15500	4090	15500
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other @ STP						365	1380	365	1380	365	1380
TOTAL				14.1	22-1.22	365	1380	5015	19010	5015	19010

Scope of Study: Comprehensive survey of major water users followed by meetings with potential users of reclaimed water

Project Status: 1 MGD pilot plant at S.D. No. 1 under construction

Implementation Problems:											
Public Health											
Financial								X		X	
Lack of Demand											
Institutional								X		X	
Other											

References: "Alternative Reclaimed Water Systems - An Interim Report" by EBMUD, June 1976

[1] Similar to EBMUD Alt. 112A w/o Tilden Park, U.C. Berkeley & Mt. View Group; unit costs would be less than above

[2] EBMUD Alt. 111

[3] w/o federal grant

EAST BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

SAN LEANDRO SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape				.84[1]	17-52			165	620	165	620
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other San Leandro Filter Plant	1978	365	1380			365	1380	365	1380	365	1380
TOTAL		365	1380	.84	17-52	365	1380	530	2000	530	2000
Implementation Problems:											
Public Health											
Financial								X		X	
Lack of Demand											
Institutional								X		X	
Other											

Scope of Study: Comprehensive survey of major water users followed by meetings with potential users of reclaimed water

Project Status: Part of Step 1 Facility Plan being done by EBMUD, Scheduled for completion in 1978. 1 MGD Filter Plant Reclamation Facility will be constructed.

References:
"Alternative Reclaimed Water Systems - An Interim Report" by EBMUD, June 1976
"Wastewater Reclamation Study" for EBMUD by Bechtel, 1974
"Wastewater Reclamation for Beneficial Reuse - An Initial Program for the City of San Leandro, by Jenks and Adamson, Sept 1972.
"Environmental Impact Report for San Leandro Filter Plant Reclamation Facility" EBMUD 197[illegible]

[1] Federal Grant

EAST BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

CASTRO VALLEY, SAN LORENZO, HAYWARD SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 $	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape										100	380
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL										100	380

Scope of Study: EBMUD Study emphasized areas proximate to San Leandro STP (ie in EBMUD water service area)

Project Status: Part of East Bay Dischargers Authority Step 1 F.P. for Reclamation-Reuse

Implementation Problems:

Problem	
Public Health	
Financial	X
Lack of Demand	X
Institutional	
Other	

References: "Wastewater Reclamation Study" prepared for EBMUD by Bechtel Corp., 1974.

EAST BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

UNION SANITARY DISTRICT SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture								1450	5500	1450	5500
Landscape								360	1360	360	1360
Open Space											
Marsh Enhancement								540	2020	540	2020
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined								180	680	180	680
Commercial											
Fire Protection											
Construction											
Other											
TOTAL								2530	9560	2530	9560

Scope of Study: Reuse study conducted to determine whether wastewater transport requirements of 20 MGD to EBDA could be reduced

Project Status: Step 1 reclamation study for EBDA to be started in 1977 or 78.

Implementation Problems:	
Public Health	
Financial	X
Lack of Demand	X
Institutional	X
Other	

References: "Wastewater Reclamation and Reuse Study for the Union Sanitary District Area - Appendix A to Draft EIS for East Bay Dischargers Water Quality Management Program Phase I", by U.S. EPA, 1976.

Note: Reuse market in Fremont - Newark considered too far from Alvarado STP to be economically supplied with reclaimed water. 7 MGD could be supplied in Union City Area

EAST BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

CENTRAL CONTRA COSTA SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 \$	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling 19 MGD				4.3	35	5480	20700	5480	20700	5480	20700
Process 19 MGD						5480	20700	5480	20700	5480	20700
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL						10960	41400	10960	41400	10960	41400

Scope of Study: Emphasized industrial reuse

Project Status: Contracts signed with potential users; project under construction

Implementation Problems:

- Public Health
- Financial
- Lack of Demand
- Institutional
- Other

References: "Contra Costa County Water District User Cost Study", by James M. Montgomery Consulting Engineers, 1974

EAST BAY SUBREGIONAL WASTEWATER REUSE MARKET SUSPVEY 6/7

EAST CONTRA COSTA SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL											
Scope of Study	study of industrial reuse										
Project Status	Completing Step 1 Facility Plan - No reuse included; serving industrial market not feasible										
Implementation Problems:											
Public Health											
Financial											
Lack of Demand											
Institutional											
Other											
References:											

EAST BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

LIVERMORE VALLEY (LAVMA) SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 $	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture		1000	3800			1000	3800	0	0	910	2300
Landscape		130	500			130	500	0	0		
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		1130	4300			1130	4300	0	0	910	2300
Scope of Study		Depends upon LAVMA Project									
Project Status		Tentative									
Implementation Problems:											
Public Health											
Financial										×	
Lack of Demand											
Institutional										×	
Other											
References:	Personal communication with ABAG										

SOUTH BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

ALL SUBAREAS COMBINED

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge		730	2760			730	2760	730	2760	1460	5520
Irrigation:											
Agriculture						685	2590	1635	6190	1985	7590
Landscape		110	415			110	415	815	3080	2795	10580
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined										515	1960
Commercial											
Fire Protection											
Construction											
Other		410	1640			410	1540	410	1540	410	1540
TOTAL		1250	4715			1935	7305	3590	13570	7165	27190
Scope of Study											
Project Status											
Implementation Problems:											
Public Health											
Financial											
Lack of Demand											
Institutional											
Other											
References:											

SOUTH BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 1/4

CITY OF PALO ALTO SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	Quantity 10^6ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge	1977	730	2760	4.6	NA	730	2760	730	2760	1460	5520
Irrigation:											
Agriculture											
Landscape	1977	110	415	—		110	415	815	3080	815	3080
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other	1977	410	1540	—		410	1540	410	1540	410	1540
TOTAL		1250	4715	4.6	~25	1250	4715	1955	7380	2685	10140

Scope of Study: Emphasized recharge & nearby landscape irrigation

Project Status: 4 mgd AWT under construction; Step 1 study for additional recharge to begin in 1980

Implementation Problems:

	1980	1985	1990
Public Health	X	X	X
Financial		X	X
Lack of Demand			
Institutional			
Other			

References: "Wastewater Reclamation for Beneficial Reuse for City of Palo Alto" by Jenks and Adamson, 1972

1990 recharge value is assumed as twice the presently designed value

SOUTH BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 2/4

MILPITAS SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	Quantity $10^6 \ell$	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 $10^6 \ell$	1985 10^6gal	1985 $10^6 \ell$	1990 10^6gal	1990 $10^6 \ell$
Groundwater Recharge											
Irrigation:											
Agriculture				1.4	NA	685	2590	685	2590	685	2590
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL				1.4	NA	685	2590	685	2590	685	2590
Scope of Study	Market survey completed in 1975 by SCVWD; agricultural, industrial, open-space irrigation, low-flow stream augmentation										
Project Status	Step 1 F.P. underway; could be on-line in 1980										
Implementation Problems:											
Public Health						X		X		X	
Financial						X		X		X	
Lack of Demand											
Institutional											
Other crop marketability						X		X		X	

References: "Potential Reclaimed Water Markets - Milpitas Area" by Santa Clara Valley Water District, 1975

REMAINDER[1] OF NORTH SANTA CLARA CO. SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	Quantity 10^6ℓ	COST Const. 10^6 $	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge (Injection)										24400[2]	92500[2]
Irrigation:											
Agriculture											
Landscape										1980	7500
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined										65	250
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		⊖				⊖		⊖		2045	7750

Scope of Study: Emphasized large-scale reuse alternatives but also considered local markets incl. parks, golf courses, cemeteries and highway landscaping

Project Status: large projects delayed due to public heath concerns

Implementation Problems:											
Public Health										X	
Financial										X	
Lack of Demand											
Institutional											
Other											

References: "Water Reclamation and Reuse - A Study for the Santa Clara County Flood Control and Water District - Phase I Final Report" by Consoer - Bechtel, 197

[1] Excludes cities of Palo Alto and Milpitas and includes area north of I-280

2 Chances of the project being implemented appear slim and thus quantities were not included in the total

SOUTH BAY SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 4/4

GILROY, MORGAN HILL AND SOUTH SANTA CLARA CO. SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:										26,200	99,100'
Agriculture								950	3600	1300	5000
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake										"possible"	
Industrial:										"very small"	
Cooling											
Process											
Other											
Combined										450	1700
Commercial											
Fire Protection											
Construction											
Other											
TOTAL								950	3600	1750	6710

Scope of Study: Emphasized large-scale reuse alternatives but also considered local markets incl. parks, golf courses, cemetaries & highway interchanges

Project Status: large projects delayed due to public health concerns
6 mo. irrigation with Gilroy / Morgan Hill effluent assumed to be on line by 1985

Implementation Problems:

Public Health	X
Financial	X
Lack of Demand	
Institutional	
Other	

References: "Water Reclamation and Reuse - A Study for the Santa Clara County Flood Control and Water District - Phase I Final Report" by Consoer-Bechtel, 1973
and
"Overview Facilities Management Plan - South Bay Dischargers Authority by Bechtel, 1974

' This use not included in total because chances of implementation appear to be slim.

PENINSULA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

ALL SUBAREAS COMBINED

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	10^6ℓ	COST Const. 10^6 $	Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture										1665	6300
Landscape		1074	4059			1036	3921	4301	16300	5481	20760
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined								1068	4052	1389	5272
Commercial								62	234	83	314
Fire Protection											
Construction											
Other											
TOTAL		1074	4059			1091	4126	5431	20586	8618	32646
Scope of Study											
Project Status											
Implementation Problems:											
Public Health											
Financial											
Lack of Demand											
Institutional											
Other											
References:											

PENINSULA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY Y6

CITY OF SAN FRANCISCO SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	10^6ℓ	COST Const. 10^6 $	Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape	1932	365	1380			365	1380	1580[1]	6000	1580	6000
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial								210	800	210	800
Fire Protection											
Construction											
Other											
TOTAL		365	1380			365	1380	1790	6800	1790	6800
Scope of Study	Comprehensive survey of major water users (1974)										
Project Status	Must await completion of wet weather facilities plans										
Implementation Problems:											
Public Health								x		x	
Financial											
Lack of Demand								x		x	
Institutional											
Other											

References: "Final Environmental Impact Report and Statement – San Francisco Wastewater Master Plan, Appendix A – Study of the Potential for Reclamation of Wastewater" by J.B. Gilbert and Associates, 1974

[1] Excludes golf courses that can be served from the North San Mateo Co. Sanitation District

PENINSULA SUBREGIONAL WASTEWATER REUSE MARKET SUSVEY 7/6

NORTH COASTSIDE + PACIFICA SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	10^6ℓ	COST Const. 10^6 \$	Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape	1979	220	832	4.4	30	220	832	516	1950	904	3420
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined								3	12	3	12
Commercial								35	132	35	132
Fire Protection											
Construction											
Other											
TOTAL		220	832	4.4	30	220	832	554	2094	942	3564
Scope of Study	Emphasized reuse for landscape irrigation to reduce pumping of Daly City aquifer.										
Project Status	Step 1 Facility Plan complete by 1978; contract for up to 1 mgd to be supplied to Olympic Golf Club has been signed										
Implementation Problems:											
Public Health								X		X	
Financial								X		X	
Lack of Demand											
Institutional											
Other											
References:	"Wastewater Reclamation Study for the North San Mateo Co. San Dist." by Kirker Chapman Associates and "San Mateo Co. Water Quality Management Program" by Jenks and Adamson, 1973										

NORTH BAYSIDE SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	10^6ℓ	COST Const. 10^6 $	Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape		55[1]	205			76	286	1000	3790	1612	6100
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined								415	1570	551	2100
Commercial								26	98	26	98
Fire Protection											
Construction											
Other											
TOTAL		55	205			76	286	1441	5458	2189	8298

Scope of Study: Comprehensive survey of major water users (1973)

Project Status: Step 3 improvements to So. San Francisco STP to be complete by 1979; City of Burlingame doing reclamation study

Implementation Problems:											
Public Health								X		X	
Financial								X		X	
Lack of Demand								X		X	
Institutional											
Other											

References: "San Mateo Water Quality Management Program" by Jenks and Adamson, 1975

And

Letter from City of Burlingame to RWQCB - 11/16/76

[1] S.F. County Jail

PENINSULA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 4/6

CENTRAL COASTSIDE SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture										1665	6300
Landscape	1979	60	228			60	228	85	320	85	320
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL	1979	60	228			60	228	85	320	1750	6620

Scope of Study: General, emphasized landscape and reuse by nurseries. Future increase based upon irrigating 1180 acre Ag. preserve

Project Status: Subregional system Step 3 complete by 1979; contract made with local golf course for 0.3 mgd, talking to other users

Implementation Problems:						1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Public Health										X	
Financial						X		X		X	
Lack of Demand										X	
Institutional											
Other											

References: "San Mateo Mid-Coastside Project Report" by TYA et al, 1975 and "San Mateo Co Water Quality Management Program" by Jenks and Adamson, 1973

CENTRAL BAYSIDE SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape		370	1400	0.6	NA	370	1400	465	1760	465	1760
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial						1	4	1	4	1	4
Fire Protection											
Construction											
Other											
TOTAL		370	1400	0.6	NA	371	1404	466	1764	466	1764

Scope of Study: Comprehensive survey (1973) of major water users

Project Status: Step I F.P. underway; capacity of 2-4 mgd to be provided for park and golf course irrigation

Implementation Problems:	1980	1985	1990
Public Health		X	X
Financial		X	X
Lack of Demand		X	X
Institutional			
Other			

References: "San Mateo Co. Water Quality Management Program." by Jenks and Adamson, 1973
and
Letter from City of San Mateo to RWQCB - 11/10/76

PENINSULA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 6/6

SOUTH BAYSIDE SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape		4[1]	14					655	2480	835	3160
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined								440	1670	625	2360
Commercial										21	80
Fire Protection											
Construction											
Other											
TOTAL		4	14			0	0	1095	4150	1481	5600
Scope of Study	Comprehensive survey of major water users (1973)										
Project Status		—									
Implementation Problems:											
Public Health								X		X	
Financial								X		X	
Lack of Demand								X		X	
Institutional											
Other											

References: "San Mateo Co Water Quality Management Program" by Jenks and Adamson, 1973

[1] Includes San Mateo Co Boys Ranch and San Francisco Log Cabin Ranch

NAPA - SOLANO SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

ALL SUBAREAS COMBINED

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	10^6ℓ	COST Const. 10^6 $	Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture		110	410			3150	11890	4750	18100	8430	32010
Landscape											
Open Space						95	360	125	470	130	490
Marsh Enhancement						1400	5300	2100	7900	3000	11400
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		110	410			4645	17550	6975	26470	11560	43900
Scope of Study											
Project Status											
Implementation Problems:											
Public Health											
Financial											
Lack of Demand											
Institutional											
Other											
References:											

NAPA - SOLANO SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 1/6

FAIRFIELD - SUISUN SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture						2040[1]	7700	3000	11500	4300	16400
Landscape											
Open Space											
Marsh Enhancement					-	1400[1]	5300	2100	7900	3000	11400
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL						3440	13000	5100	19400	7300	27800

Scope of Study: studied various discharge options incl irrigation & marsh

Project Status: construction scheduled to begin in 1979-80

Implementation Problems:

Public Health

Financial

Lack of Demand

Institutional

Other

References: "Draft Environmental Impact Report - Wastewater Management and Reclamation Facilities - City of Fairfield" by J.B. Gilbert and Associates, 1974.

[1] distribution of effluent assumes that Solano Irrigation District uses all effluent during growing season

NAPA - SOLANO SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

2/6

BENICIA SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	Quantity 10^6ℓ	COST Const. 10^6 $	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture					.37	425	1600	425	1600	425	1600
Landscape					.16	21	80	21	80	21	80
Open Space											
Marsh Enhancement					.27	715	2700	715	2700	715	2700
Rec. Lake					.27	715	2700	715	2700	715	2700
Industrial:											
Cooling											
Process											
Other											
Combined					.90	715	2700	715	2700	715	2700
Commercial											
Fire Protection											
Construction											
Other											
TOTAL						-0-	-0-	-0-	-0-	-0-	-0-

Scope of Study: considered all major water uses and potential reuses

Project Status: Step 2 underway for secondary STP and bay discharge - no reuse planned

Implementation Problems:

Problem	1980	1985	1990
Public Health			
Financial	X	X	X
Lack of Demand	X	X	X
Institutional			
Other			

References: "Subregional Wastewater Management Program - City of Benicia" by J. Warren Nute, 1974

"It was concluded that the potential could not be realized because of financial limitations and lack of demand; therefore the total excludes all potential reuses"

NAPA - SOLANO SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

NAPA - CARNEROS AREA SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	10^6ℓ	COST Const. 10^6 $	Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	10^6ℓ	1985 10^6gal	10^6ℓ	1990 10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture				7.4	.09	1000[1]	3780	1620	6120	4000	15120
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL				7.4	.09	1000	3780	1620	6120	4000	15120

Scope of Study: Survey of potential uses in Carneros Valley Area - Alternatives and costs identified

Project Status: More detailed study to follow

Implementation Problems:	1980	1985	1990
Public Health	X	X	X
Financial	X	X	X
Lack of Demand			
Institutional			
Other			

References: "Carneros Area Agricultural Water Supply Study" by Napa County Flood Control and Water Conservation District, October 1976

[1] assumes 6 mo. irrigation w/o winter effluent storage initial and then in 1990 storage to utilize entire flow from Napa S.D. and American Canyon C.W.D.

NAPA-SOLANO SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 4/6

CALISTOGA SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape						50	190	80	300	80	300
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL						50	190	80	300	80	300

Scope of Study: Emphasized landscape irrigation - Dry season only

Project Status: Contracts to receive reclaimed water being negotiated.

Implementation Problems:

Public Health

Financial

Lack of Demand

Institutional

Other

References: "Amendment to the Project Report on Wastewater Treatment Improvements - wastewater Reclamation Pipeline, City of Calistoga, California" by Kennedy Engineers, Dec 1976.

NAPA-SOLANO SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 5/6

YOUNTVILLE SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6 gal	Quantity 10^6 ℓ	COST Const. 10^6 \$	COST Unit ¢/kgal	PROJECTED REUSE 1980 10^6 gal	1980 10^6 ℓ	1985 10^6 gal	1985 10^6 ℓ	1990 10^6 gal	1990 10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture	1939	60	230			60	230	80	300	80	310
Landscape						45	170	45	170	50	190
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		60	230			105	400	125	470	130	500

Scope of Study: considered landscape/agricultural irrigation

Project Status: Step 2 Design underway for joint City-Veterans home STP with summer irrigation and winter river discharge

Implementation Problems:

Public Health

Financial

Lack of Demand

Institutional

Other

References: "Project Report on Wastewater Treatment and Disposal - City of Yountville - February 1975 Amendment" by Kennedy Engineers, 1975

NAPA - SOLANO SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

ST. HELENA SUBAREA

6/6

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture		50	180			50	180	50	180	50	180
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		50	180			50	180	50	180	50	180

Scope of Study

Project Status: Continuing operation at Pacific Union College, Angwin, Napa Co.

Implementation Problems:

Public Health

Financial

Lack of Demand

Institutional

Other

References: "Reclamation and Reuse of Wastewater in San Francisco Bay Region" by BASSA, 1975

MARIN-SONOMA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

ALL SUBAREAS COMBINED

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture		317	1164			1895	7200	2520	9530	3125	11795
Landscape		15	60			240	905	300	1130	590	2225
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		332	1224			2135	8105	2820	10660	3715	14020
Scope of Study											
Project Status											
Implementation Problems:											
Public Health											
Financial											
Lack of Demand											
Institutional											
Other											
References:											

MARIN – SONOMA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

SONOMA VALLEY SUBAREA

1/5

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT. Date on Line	Quantity 10^6gal	Quantity 10^6ℓ	COST Const. 10^6 \$	Unit ¢/kgal	PROJECTED REUSE 1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture		300	1100			360	1360	450	1700	540	2020
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		300	1100			360	1360	450	1700	540	2020

Scope of Study: Evaluated irrigation along with other disposal options

Project Status: Entering Step 2 design, undecided on winter discharge or storage; above totals based upon 6 mo. irrigation

Implementation Problems:

Public Health

Financial

Lack of Demand

Institutional

Other

References: "Project Report for Water Reclamation and Pollution Control Facilities – Sonoma Valley County Sanitation District" by Trotter-Yoder and Associates 1975

MARIN - SONOMA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

2/5

SOUTHERN SONOMA SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture						730	2800	1150	4350	1550	5860
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL						730	2800	1150	4350	1550	5860

Scope of Study

Project Status: Presently completing Step 1; Apparent best alternative is to use effluent for agricultural irrigation six months of the year

Implementation Problems:

Public Health

Financial

Lack of Demand

Institutional

Other

References: "Environmental Impact Report for Marin - Sonoma Wastewater Management Program" being prepared by J. B. Gilbert and Associates

MARIN-SONOMA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

3/5

NORTH MARIN SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6 gal	10^6 ℓ	10^6 $	¢/kgal	10^6 gal	10^6 ℓ	10^6 gal	10^6 ℓ	10^6 gal	10^6 ℓ
Groundwater Recharge											
Irrigation:											
Agriculture						755	2850	865	3270	975	3685
Landscape	1976	15	60	1.4		165	625	175	655	410	1545
Open Space											
Marsh Enhancement						Possible at Las Gallinas					
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		15	60			920	3475	1040	3925	1385	5230

Scope of Study: Includes facilities at Las Gallinas and Marin Bay for Landscape Irrigation & Novato/Ignacio Reuse for Agricultural Irrigation 6 months of the year

Project Status: Pilot reclamation plant at Las Gallinas (1 MGD) in operation; contracts will have to be negotiated to realize agricultural reuse potential - awaiting Step I facility plan

Implementation Problems:	1980	1985	1990
Public Health			
Financial	x	x	x
Lack of Demand	x	x	x
Institutional			
Other			

References: "Las Gallinas Valley Wastewater Reclamation Project - Draft Environmental Impact Report" by McKinne Associates, 1975

"Marin - Sonoma Wastewater Program Analysis" by J. Warren Nute et al, 1975

MARIN - SONOMA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY

4/5

SOUTH - CENTRAL MARIN SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture											
Landscape				.6		75	280	125	475	180	680
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL				.6		75	280	125	475	180	680

Scope of Study: Two projects - one in Lower Ross Valley, one for the City of Mill Valley

Project Status: Nearing Completion of Step 1 Facility Planning

Implementation Problems:	Date on Line	10^6gal	10^6ℓ	10^6 $	¢/kgal	1980 10^6gal	1980 10^6ℓ	1985 10^6gal	1985 10^6ℓ	1990 10^6gal	1990 10^6ℓ
Public Health								x		x	
Financial								x		x	
Lack of Demand											
Institutional											
Other											

References: Personal Communication with Marin Municipal Water District, Jan 25, 1977

MARIN-SONOMA SUBREGIONAL WASTEWATER REUSE MARKET SURVEY 5/5

WEST MARIN SUBAREA

IDENTIFIED MARKETS	EXISTING OR UNDER DESIGN/CONSTRUCT.			COST		PROJECTED REUSE					
	Date on Line	Quantity		Const.	Unit	1980		1985		1990	
		10^6gal	10^6ℓ	10^6 $	¢/kgal	10^6gal	10^6ℓ	10^6gal	10^6ℓ	10^6gal	10^6ℓ
Groundwater Recharge											
Irrigation:											
Agriculture	1976	17	64			50	190	55	210	60	230
Landscape											
Open Space											
Marsh Enhancement											
Rec. Lake											
Industrial:											
Cooling											
Process											
Other											
Combined											
Commercial											
Fire Protection											
Construction											
Other											
TOTAL		17	64			50	190	55	210	60	230

Scope of Study: Spray Irrigation was recommended alternative for Bolinas, Tomales Bay and Pt. Reyes

Project Status: Bolinas on-line; Tomales and Pt. Reyes in Design

Implementation Problems:

Public Health

Financial

Lack of Demand

Institutional

Other

References:

"Project Report and Feasibility Study for Wastewater Treatment and Disposal System" by Kirker Chapman & Associates, 1972

"Facility Plan and EIR for Pt Reyes Station", by North Marin Municipal Water District 1976

"Facility Plan and EIR for Tomales Bay" by North Marin Municipal Water District, 1974

WCRS/Tech Memo 14/April 1977
B. Maddaus

WATER CONSERVATION, REUSE, AND SUPPLY PLAN

PRELIMINARY WATER-USE PROJECTIONS FOR BAY AREA

TECHNICAL MEMORANDUM NO. 14

APRIL 19, 1977

INTRODUCTION

Projections of future water use are being developed within the Scope of the Water Conservation, Reuse, and Supply element of the Environmental Management Plan being prepared by ABAG under the auspices of Section 208 of PL 92-500. The purpose of these projections is to evaluate the water savings possible from various water conservation plans, to help quantify the potential for wastewater reclamation, and to evaluate the need for new water supply development projects. The projections are long-range, through the year 2000, and cover the entire nine-county Bay Area with sufficient detail to evaluate the effect of individual wastewater reuse projects and to identify potential water deficient areas.

The ABAG Provisional Series III population and land-use projections are the basis of the water-use projections. These projections use 1975 as a base year and, in their present form, provide 1990 projections of population, number of occupied single family and multiple family dwelling units, number of commercial and industrial employees, residential land-use acreage, and other parameters in each of 440 zones that cover the entire nine-county area. A 440 zone constitutes one or more census tracts (with an average of two tracts). This detailed information permits a level of accuracy in water-use projections not previously possible on a regional scale.

Two alternative population projections--Base Case 1 and Base Case 2--have been developed. Base Case 1 is the higher of the two, but is lower than the commonly used 1974 State Department of Finance's D-100 series. Consequently, the water use projections presented here are likely to be lower than projections reported previously. The 1990 Base Case 1 population projections were used for these water-use projections.

APPROACH

Water-Use Categories

The following water-use categories were used to provide the best possible accuracy in the projections given the information and data available:

1. Inside Residential
2. Outside Residential
3. Commercial/Industrial
4. Public
5. Unaccounted-for Water
6. Agricultural Irrigation

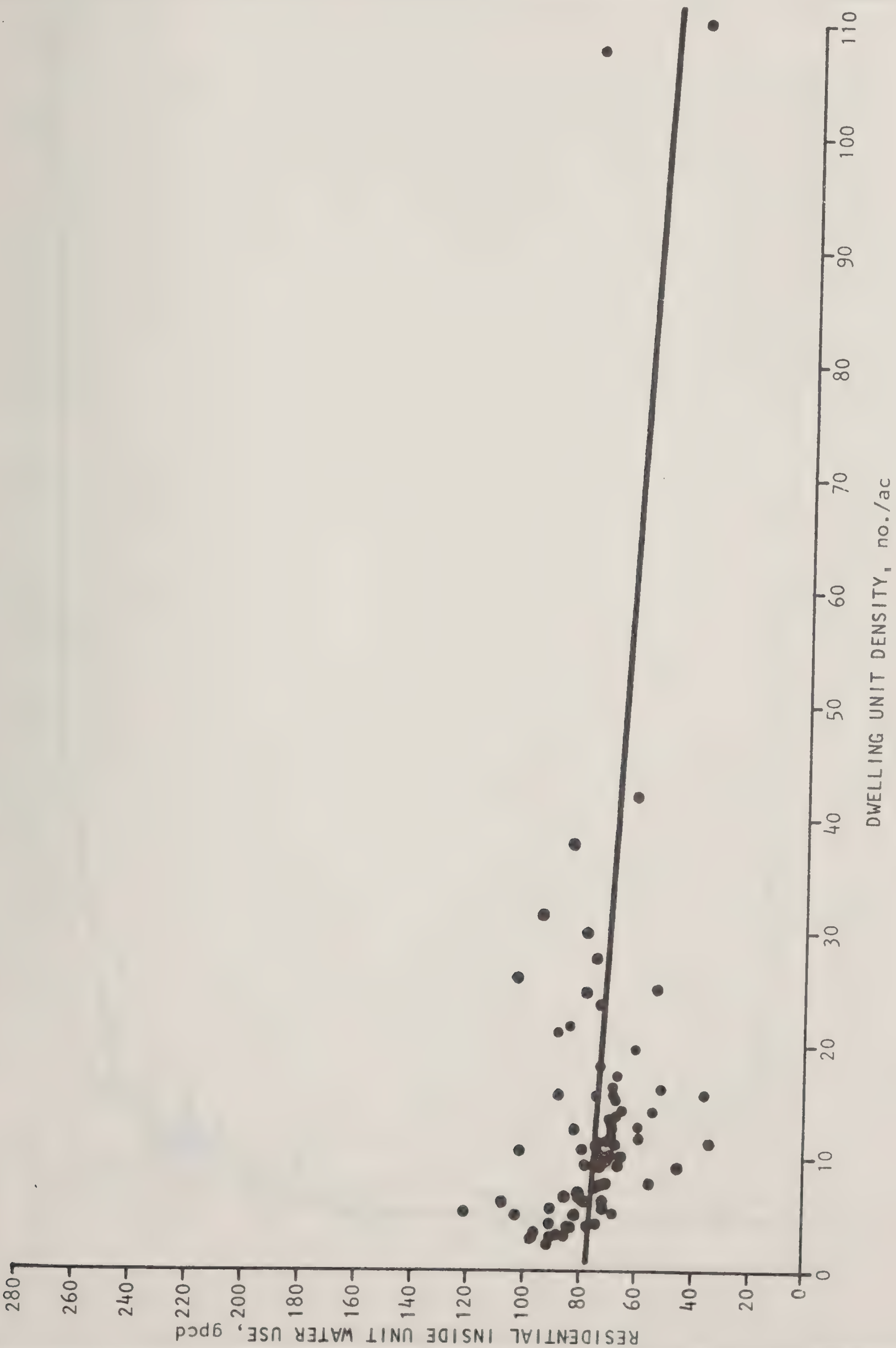
Municipally-Supplied Water

Detailed data covering the first three categories were obtained from the East Bay Municipal Utility District. A breakdown of water use for the year 1975 for each of the District's 102 440 zones was provided. Using these data and the 1975 population and land-use data from ABAG, a set of relations between water use and residential population or commercial/industrial employee population was developed.

The three curves are in Figures 1, 2, and 3. As shown in Figure 1, residential inside water use, expressed as gallons per capita per day (gpcd), has been plotted against residential dwelling unit density, expressed as number of occupied dwelling units per net residential area in acres. This curve was derived from February 1975 EBMUD water-use data, which is considered to be representative of inside residential water use because of the large amount of rainfall that occurred that particular month.

Residential outside water use in gallons per dwelling unit per day (gpdud) versus residential dwelling unit density, expressed as dwelling units per net residential acre, is shown on Figure 2. This curve was derived by subtracting inside water use from total residential water use for each EBMUD 440 zone and relating this consumption to density. This curve shows a dramatic decrease in consumption from over 300 gpdud at typical single family densities to under 10 gpdud for high densities associated with apartments.

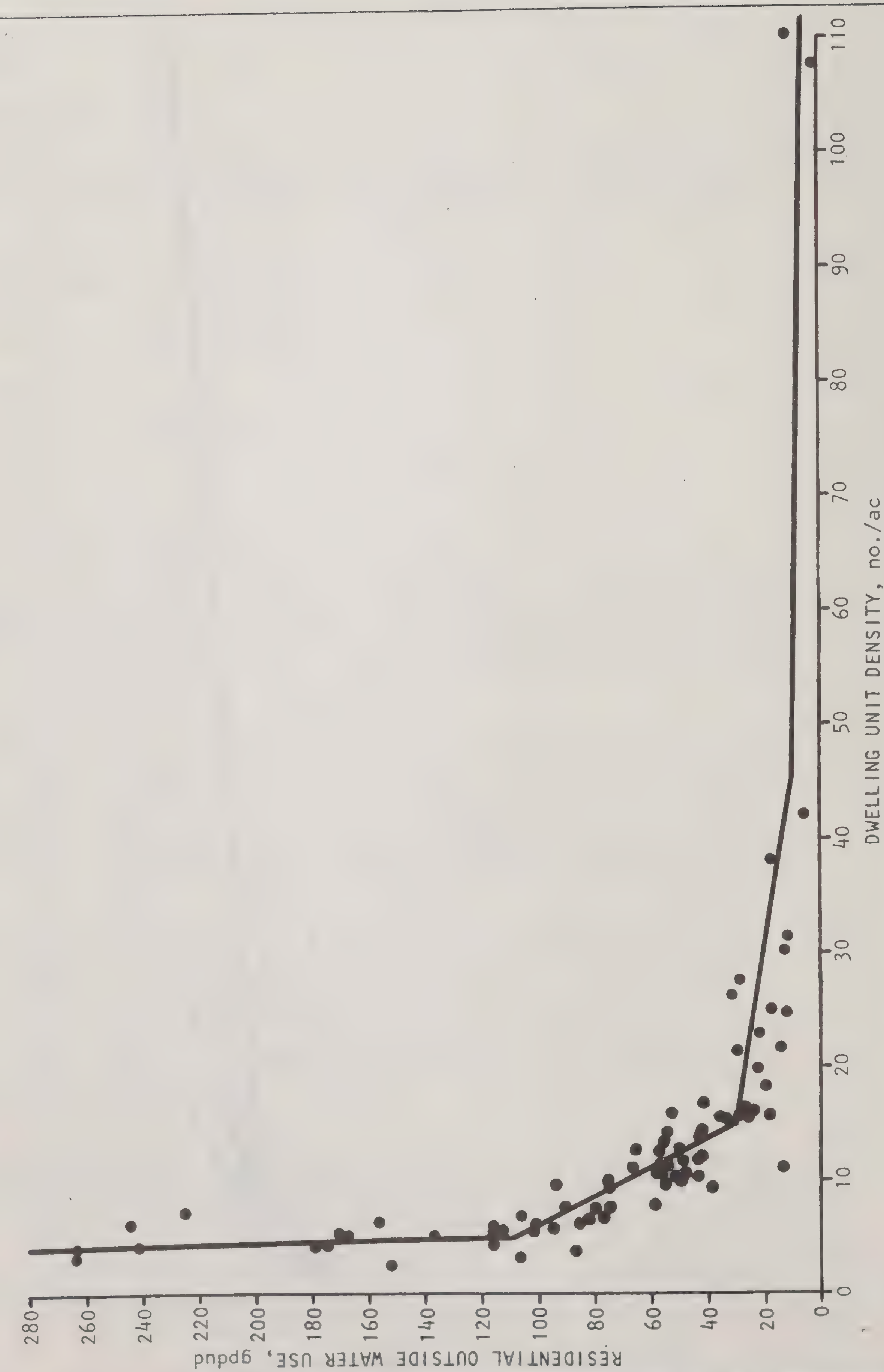
Combined commercial and industrial water use on a gallons per employee per day (gped) versus employee density, expressed as employees per net commercial and industrial acreage, was related using EBMUD data. This plot is shown in Figure 3. The oil refineries were treated as a special case. The trend is a decrease in water use per employee as density increases. This category excludes self-supplied industrial cooling water and power plant cooling water.



INSIDE RESIDENTIAL
UNIT WATER USE RELATIONSHIP

JBGA/DLF/RTC 4/77

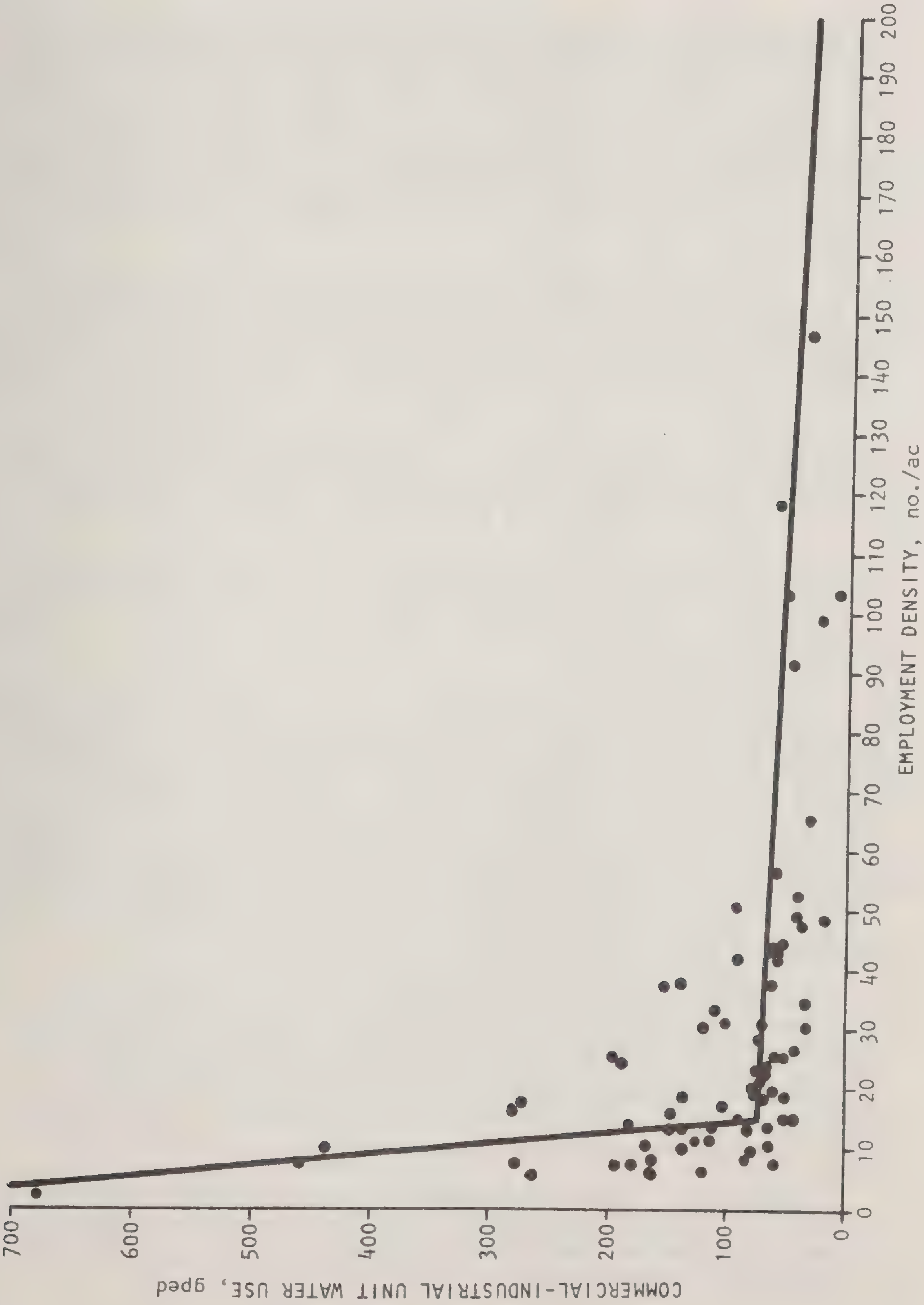
FIGURE 1



OUTSIDE RESIDENTIAL
UNIT WATER USE RELATIONSHIP

JBGA/DLF/RTC 4/77

FIGURE 2



COMMERCIAL-INDUSTRIAL
UNIT WATER USE RELATIONSHIP

JBGA/DLF/RTC 4/77

FIGURE 3

In applying these curves throughout the Bay Area it is expected that water use would be overpredicted in some cases and underpredicted in others. To account for this fact, actual water-use data for 1975 were obtained for the above categories from the largest 20 water distribution agencies in the Bay Area. The projection curves were then adjusted for each 440 zone using these data. Factors used to adjust the projection curves generally varied within plus or minus 40 percent for residential water use and plus or minus 70 percent for commercial/industrial water use.

Public authority water use was handled as a percentage of the subtotal of residential and commercial/industrial water use in each 440 zone. Percentages were derived from actual data of the water distribution agencies or from a nearby agency if no detailed data were available for the zone. Percentages generally ranged from 1 to 18 percent.

Unaccounted-for water includes unmetered water from fire hydrants and water losses. This was handled as a percentage of residential, commercial/industrial and public use and was based upon actual data where available. Percentages ranged from 3 to 11 percent.

The water-use projections were performed by a computer. The computer program incorporates all the above relations and computes water use in all categories for each 440 zone for a given year.

Agricultural Irrigation

Estimating irrigation requirements for the Bay Area is difficult because much of the water is supplied by unmetered private wells. Records of agricultural acreage are maintained on a crop-by-crop basis by each County Agricultural Commissioner. Those crops which are generally irrigated in each county were determined by conversations with the respective Commissioners. Water use factors (applied water in acre-feet per acre per year) were obtained from the State Department of Water Resources Bulletin 113-3, "Vegetative Water Use in California, 1974". A tabulation of the crops which were assumed to be irrigated in each county and the appropriate water use factors are shown in Table 1.

Projection of future irrigated acreage through year 2000 were made by considering historical trends, projected population growth, projected increases in land devoted to urban activities, and market factors. Historical trends in crop acreage obtained from the county agricultural crop reports are shown in Table 2. These are the major categories of crops, not all of which are irrigated in each county. The assumptions used in making the projections are as follows:

Vegetables. Total crop acreage in the Bay Area will increase in proportion to population growth. A decline in vegetable acreage in some counties will be more than offset by growth in other, less urbanized counties such as Solano County.

TABLE 1

PERCENTAGE OF CROP TYPE IRRIGATED AND WATER APPLICATION FACTORS
(ac-ft/ac irrigated land)

County	Field Crops	Vegetables	Fruit & Nuts	Vineyards	Horticultural	Irrigated Pasture
Alameda	15%	100%	100%	100%	100%	100%
	2.9	2.3	2.8	0.8	3.4	3.4
Contra Costa	76%	100%	100%	100%	100%	100%
	2.1	2.5	2.8	1.7	3.9	3.9
Marin	4%	100%	100%	100%	100%	100%
	1.7	→ included	2.0	← included	1.7	3.4
Napa	14%	100%	100%	100%	100%	100%
	1.7	1.7	2.0	1.5	1.7	3.4
San Francisco	-	-	-	-	-	-
San Mateo	0%	100%	100%	100%	100%	100%
	-	2.0	2.8	0.8	2.3	3.3
Santa Clara	60%	100%	100%	100%	100%	100%
	2.9	2.1	2.6	1.0	2.1	3.3
Solano	58%	100%	100%	100%	100%	100%
	2.5	2.4	2.4	2.2	2.4	4.1
Sonoma	0%	100%	100%	100%	100%	100%
	-	1.7	2.0	1.5	1.7	2.8

TABLE 2

HISTORICAL CROP ACREAGE

County	Year	Field Crops	Vege-tables	Fruit & Nuts	Vineyards	Horti-cultural	Irrigated Pasture	Total
Alameda	1958	41,689	13,047	4,103	2,438	224	3,121	64,622
	60	39,857	14,569	4,139	2,438	600	2,441	64,044
	66	22,658	11,184	2,916	1,800	824	1,640	41,022
	70	19,895	7,533	1,598	1,750	352	1,200	32,328
	75	28,980	4,414	978	1,757	520	910	37,559
Contra Costa	1958	36,603	16,886	29,799	2,464	-	-	-
	60	38,449	16,936	25,787	1,720	92	7,000	89,974
	66	37,391	12,442	19,653	1,442	91	7,500	78,519
	70	31,210	7,230	17,725	1,218	25	7,060	64,468
	75	27,780	8,480	12,157	1,051	167	5,600	55,235
Marin	1955	4,792	113	129	48	27	-	-
	60	5,944	20	95		54	750	6,863
	66	3,500	20	55		66	800	4,441
	70	5,000		90		145	800	6,035
	75	4,600	included	30	included	150	530	5,310
Napa	1960	6,503	300	13,163	9,623	300	2,500	32,389
	66	5,226	230	7,761	11,381	500	2,150	27,248
	70	5,375	-	6,015	12,254	-	1,500	-
	75	8,358	2,786	3,200	15,725	-	400	-
San Francisco		All values zero						
San Mateo	1957	23,398	5,968	379	18	1,146	-	-
	60	17,932	4,653	343	7	1,021	1,211	25,167
	66	8,220	3,306	157	-	888	660	-
	70	4,879	3,326	151	14	1,216	647	10,219
	75	5,602	3,587	213	20	1,255	542	11,199
Santa Clara	1950	16,862	26,277	80,865	5,150	631	-	-
	60	17,900	14,220	62,700	3,752	653	4,200	103,425
	66	17,535	15,632	47,583	3,145	730	1,800	86,425
	70	13,534	15,615	36,011	2,603	467	1,400	69,630
	75	14,400	15,617	20,756	2,334	438	1,500	55,045
Solano	1957	127,979	20,066	17,341	636	1,706	-	-
	60	118,305	14,748	17,254	593	-	19,000	-
	66	118,445	12,153	15,825	635	-	23,500	-
	70	127,930	13,907	19,381	790	3,110	24,500	189,618
	75	120,976	22,991	17,218	1,647	2,162	25,800	190,794
Sonoma	1958	38,755	1,121	27,348	11,262	-	15,000	-
	60	45,423	436	26,342	10,700	111	15,000	98,012
	66	36,760	370	28,294	11,600	24	15,000	92,048
	70	28,270	260	27,831	12,597	31	15,000	83,989
	75	25,275	240	16,424	16,176	16	9,000	67,131

Vineyard. Indications are that grapes have been overplanted and so acreage is assumed to be stable through the year 2000. Most of the acreage is outside urban growth areas.

Horticulture. This is a profitable crop and recent upward trends are expected to continue.

Fruit and Nuts. This crop has seen dramatic reductions in acreage due to higher production costs and urban development pressure. Further reductions in crop acreage are anticipated.

Irrigated Pasture. A continued decline in irrigated pasture is anticipated, except in Sonoma County where reclaimed wastewater will be available.

Field Crops. Future field crop acreage was in part based upon the relation between the changes in the other five categories and the total required for new urban development. There is insufficient acreage in this category to make a land balance with urban growth; however, large declines in field crop acreage are anticipated.

Projections of future agricultural water use were made using these crop acreage projections and assuming that the percentage of each crop that is irrigated remains the same along with the water use factor.

WATER-USE PROJECTIONS

Municipal

Base Projection. The base projection assumes ABAG Series III Base Case 1 for population growth by the year 1990. Shown in the attached tables are the county-level water-use figures for 1975 and 1990 in the five water-use categories. Also shown are the water-use totals for each 440 zone for these two years.

Water Conservation Alternatives. Listed in Table 3 are the water conservation alternatives for which water projections were made. Alternatives 1 and 3 deal with the extent to which mechanical devices are installed in existing and newly constructed homes. Most of the savings on inside use are associated with toilet and shower modifications. Outside savings are based upon alternate landscape irrigation methods. Alternatives 3 through 6 range from a concerted effort in voluntary conservation, to an areawide, but not serious local water shortage, to two stages of mandatory rationing. A variable water-loss function was used in all water conservation alternatives. Recent data were supplied by DWR on the increase in efficiency that was achieved by water agencies who undertook a water loss reduction program. As one might expect, the closer the system efficiency percentage was to 100 percent, the less the opportunity for improvement. Using data from 16 agencies, mostly in northern California, a relation was developed relating potential improvement in efficiency to present efficiency. Typical efficiency improvements that would be predicted are in the range of 2 to 5 percent. Alternatives 7 and 8 combine Alternative 2 with Alternatives 3 and 4. Alternatives 5 and 6 are not really desirable alternatives but are displayed to show what could happen if the current drought were to occur in a future year--1990 in this case.

TABLE 3

WATER CONSERVATION ALTERNATIVES

Alternative No.	Level of Conservation	Residential Water Savings (Devices Only) Inside gpcd	Outside %
1	Moderate implementation of devices		
	Existing Construction	2.8	0
	New Construction	16.6	0
3	Moderate devices and additional 5% savings in all use categories	Same as 1	Same as 1
4	Moderate devices and additional 10% savings in all use categories	Same as 1	Same as 1
5	Moderate devices and additonal 25% savings in all use categories	Same as 1	Same as 1
6	Moderate devices and additional 50% savings in all use categories except 25% in commercial/industrial category	Same as 1	Same as 1
2	Maximum implementation of devices		
	Existing Construction	4.5	0
	New Construction	20.6	14.8
7	Maximum devices and additional 5% savings in all use categories	Same as 2	Same as 2
8	Maximum devices and additional 10% savings in all use categories	Same as 2	Same as 2

Water use projections for each alternative are presented in the enclosed tables, on a county basis with a breakdown by category, and on a 440-zone basis for total water use.

Agricultural Irrigation

Base Projection. The base projection was made using the projected agricultural crop acreages shown in Table 4 and the water-use factors shown in Table 1.

The base projection is shown in Table 5.

Water Conservation Alternatives. The best way to reduce water use is to improve on-farm efficiency. Shown below are typical farm efficiencies for different irrigation methods:

Irrigation Method	Typical On-Farm Efficiency
Flood	30-40%
Furrow	40-60
Sprinkler	60-80
Drip	80-90

In water-deficient areas, converting from a low efficiency method to a higher efficiency method is often cost-effective. Other factors such as proper soil conservation and irrigation during calm weather periods are also important. Changing crops from a high water-using crop like alfalfa to a low water-using crop like vineyard will also save water. In view of these facts, rather substantial savings in water use could have been assumed; however, according to DWR Bulletin 113-3, many crops in the Bay Area are under-irrigated. Therefore a water savings of 15 percent has been assumed for the water conservation alternative. This projection is also shown in Table 5.

TABLE 4

PROJECTED CROP ACREAGE

County	Year	Field Crops	Vege-tables	Fruit & Nuts	Vineyards	Horti-cultural	Irrigated Pasture	Total
Alameda	1980	24,600	4,000	700	1,800	500	800	32,400
	85	19,600	3,500	600	1,800	500	600	26,600
	90	15,100	3,000	400	1,800	500	500	21,300
	95	10,500	2,500	200	1,800	500	400	15,900
	2000	6,000	2,000	0	1,800	500	300	10,600
Contra Costa	1980	22,400	8,800	11,700	1,000	100	4,500	48,500
	85	17,400	9,200	11,300	1,000	100	3,500	42,500
	90	12,200	9,600	10,900	1,000	100	2,500	36,300
	95	7,000	10,000	10,500	1,000	100	1,500	30,100
	2000	2,000	10,400	10,000	1,000	100	500	24,000
Marin	1980	4,300		100		100	400	4,900
	85	3,800		100		100	300	4,300
	90	3,600		100		100	300	4,100
	95	3,300		100		100	200	3,700
	2000	3,000	$\rightarrow$ included	100	$\leftarrow$ included	100	100	3,300
Napa	1980	6,800	2,900	2,700	15,700	600	300	29,000
	85	5,500	3,000	2,300	15,700	600	200	27,300
	90	4,100	3,200	1,900	15,700	600	200	25,700
	95	2,800	3,300	1,400	15,700	700	100	24,000
	2000	1,500	3,500	1,000	15,700	700	0	22,400
San Francisco		All values zero						
San Mateo	1980	4,800	3,800	200	0	1,400	400	10,600
	85	4,200	4,100	200	0	1,400	400	10,300
	90	3,400	4,400	200	0	1,400	300	9,700
	95	2,800	4,700	200	0	1,500	200	9,400
	2000	2,000	5,000	200	0	1,500	200	8,900
Santa Clara	1980	12,000	14,500	16,800	2,700	1,000	1,400	48,400
	85	9,400	13,200	13,200	3,200	1,200	1,200	41,400
	90	6,900	12,100	9,500	3,800	1,600	1,000	34,900
	95	4,500	11,000	5,800	4,300	1,900	900	28,400
	2000	2,000	10,000	2,000	5,000	2,300	800	22,100
Solano	1980	110,000	26,200	17,300	3,000	2,500	26,200	185,200
	85	100,000	29,000	17,300	4,700	3,200	27,200	181,400
	90	90,000	32,200	17,300	6,500	4,000	28,000	178,000
	95	80,000	35,000	17,300	8,000	4,400	29,000	173,700
	2000	70,000	37,000	17,300	9,800	5,000	30,000	169,100
Sonoma	1980	23,000	300	14,100	16,000	100	9,000	62,500
	85	21,000	500	11,700	16,000	200	9,000	58,400
	90	19,000	600	9,400	16,000	300	9,000	54,300
	95	17,000	800	7,200	16,000	400	9,000	50,400
	2000	15,000	1,000	5,000	16,000	500	9,000	46,500

TABLE 5

PROJECTED IRRIGATED ACREAGE AND WATER REQUIREMENT

County	Data	1975	1980	1985	1990	1995	2000
Alameda	Acreage	13,000	11,500	9,900	8,500	7,000	5,500
	Requirement (ac-ft)	31,700	27,700	23,400	19,429	15,400	11,400
	w/ Conservation (ac-ft)	27,000	25,600	19,900	16,500	13,100	9,700
Contra Costa	Acreage	48,500	43,100	38,300	33,400	28,400	23,500
	Requirement (ac-ft)	122,940	110,200	98,200	85,800	73,500	61,200
	w/ Conservation (ac-ft)	104,500	93,600	83,400	73,000	62,500	52,000
Marin	Acreage	800	800	700	600	500	400
	Requirement (ac-ft)	2,400	2,000	1,600	1,600	1,300	900
	w/ Conservation (ac-ft)	2,100	1,700	1,400	1,400	1,100	800
Napa	Acreage	23,800	23,200	22,600	22,200	21,600	21,100
	Requirement (ac-ft)	38,900	37,500	36,300	35,500	34,200	33,000
	w/ Conservation (ac-ft)	33,100	31,900	30,800	30,100	29,000	28,100
San Francisco		All values zero					
San Mateo	Acreage	5,400	5,800	6,100	6,300	6,600	6,900
	Requirement (ac-ft)	12,000	12,700	13,300	13,600	14,100	14,700
	w/ Conservation (ac-ft)	10,200	10,800	11,300	11,500	12,000	12,500
Santa Clara	Acreage	48,100	43,600	37,600	32,100	26,600	21,300
	Requirement (ac-ft)	114,900	104,400	88,100	72,600	57,300	42,100
	w/ Conservation (ac-ft)	97,700	88,800	74,900	61,700	48,700	35,800
Solano	Acreage	137,400	139,000	139,400	140,200	140,100	139,700
	Requirement (ac-ft)	379,600	383,900	385,700	388,000	388,600	388,400
	w/ Conservation (ac-ft)	322,700	326,300	327,800	329,800	330,300	330,100
Sonoma	Acreage	41,900	39,500	37,400	35,300	33,400	31,500
	Requirement (ac-ft)	82,700	78,100	73,800	69,500	65,600	61,700
	w/ Conservation (ac-ft)	70,300	66,400	62,700	59,100	55,800	52,500

BASE CASE FOR 1975, USING ABAG DATA

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	85.583	31.351	64.311	7.150	17.107	205.502
CONTRA COSTA	45.417	26.046	31.379	4.975	8.195	116.012
MARIN	14.606	12.452	4.085	1.984	3.393	36.521
NAPA	5.060	4.034	4.723	1.024	1.617	16.457
SAN FRANCISCO	30.453	4.590	50.226	9.098	5.096	99.463
SAN MATEO	43.951	21.837	24.646	4.363	3.002	97.801
SANTA CLARA	98.580	42.531	55.421	14.376	15.031	225.939
SOLANO	14.291	6.477	8.904	6.871	1.839	38.381
SONOMA	13.768	8.495	8.327	1.952	2.081	34.623

BASE CASE FOR 1975, USING ABAG DATA

TOTAL IN 1000S OF GALLONS PER DAY

440 ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	312.	1028.	1204.	1043.	2437.	2029.	2131.	792.	1397.	1667.
11 TO 20	636.	1023.	957.	1253.	2554.	1361.	987.	2134.	1316.	1728.
21 TO 30	1201.	669.	359.	619.	2251.	1042.	607.	206.	447.	1127.
31 TO 40	2475.	2276.	4494.	4192.	2214.	1663.	950.	501.	993.	525.
41 TO 50	1702.	2821.	1960.	3610.	2514.	1730.	891.	1129.	156.	1641.
51 TO 60	1306.	1554.	1547.	5776.	2456.	1603.	2558.	2423.	1608.	2729.
61 TO 70	2684.	1443.	3531.	538.	3192.	6490.	1779.	1019.	734.	994.
71 TO 80	1390.	3667.	1450.	2788.	2127.	880.	2810.	1782.	677.	969.
81 TO 90	1168.	924.	3262.	2570.	2458.	756.	2151.	1067.	3897.	816.
91 TO 100	1730.	1949.	2225.	2882.	1431.	1608.	1317.	1465.	2908.	2890.
101 TO 110	1904.	2233.	5266.	3717.	2100.	3927.	510.	1746.	2591.	5560.
111 TO 120	1514.	3056.	3855.	3934.	1928.	1694.	10106.	1987.	1350.	757.
121 TO 130	1426.	1894.	1009.	995.	1836.	1293.	1813.	1484.	1766.	1305.
131 TO 140	396.	1084.	2129.	1848.	1129.	1917.	1859.	1533.	1882.	1192.
141 TO 150	8690.	807.	796.	1849.	2698.	2181.	1926.	1417.	887.	2243.
151 TO 160	1357.	2179.	1840.	2349.	2181.	1769.	2005.	2084.	2234.	1808.
161 TO 170	1655.	2472.	990.	1699.	1122.	2158.	736.	414.	252.	4067.
171 TO 180	1099.	1882.	2103.	2773.	3063.	2147.	4283.	3476.	2827.	941.
181 TO 190	1384.	1487.	1372.	1801.	2121.	497.	2542.	2078.	5922.	7504.
191 TO 200	4187.	3201.	1865.	6775.	2532.	3812.	633.	1209.	3288.	3741.
201 TO 210	2843.	3136.	3996.	1051.	1966.	580.	342.	3248.	1558.	621.
211 TO 220	3091.	2718.	2430.	5834.	2506.	1703.	264.	2953.	777.	1656.
221 TO 230	314.	380.	408.	4672.	4896.	7520.	3277.	1259.	3876.	971.
231 TO 240	2829.	3034.	3075.	3136.	2037.	4433.	931.	2439.	2674.	2218.
241 TO 250	3903.	1939.	2455.	3068.	3118.	2843.	1911.	3975.	4078.	4115.
251 TO 260	1668.	2666.	857.	768.	2302.	3705.	1027.	3526.	2116.	1639.
261 TO 270	826.	1256.	850.	2337.	1640.	1953.	4716.	1857.	2354.	2266.
271 TO 280	1736.	239.	563.	828.	1237.	1679.	927.	3509.	5244.	3863.
281 TO 290	2038.	3244.	3701.	6078.	2910.	2947.	2893.	3027.	2593.	2228.
291 TO 300	5823.	1518.	3988.	3343.	1797.	453.	1563.	5641.	2735.	2487.
301 TO 310	871.	1759.	1614.	9100.	1558.	858.	789.	1456.	1640.	1524.
311 TO 320	320.	1551.	1966.	482.	3009.	2083.	1706.	2967.	1937.	1531.
321 TO 330	1833.	1549.	902.	2615.	452.	987.	1180.	449.	865.	1946.
331 TO 340	1298.	1140.	1577.	2309.	809.	1486.	2582.	1261.	1107.	565.
341 TO 350	1817.	1449.	2416.	2141.	1681.	3571.	1996.	1553.	862.	1143.
351 TO 360	996.	1105.	615.	693.	724.	1235.	4849.	1842.	1823.	661.
361 TO 370	1844.	1505.	3237.	691.	2125.	2936.	2219.	2563.	3038.	1943.
371 TO 380	1564.	1559.	1705.	1845.	977.	861.	3450.	529.	2167.	1629.
381 TO 390	1002.	4096.	3116.	1445.	2619.	1465.	2071.	932.	924.	836.
391 TO 400	1632.	630.	1770.	1577.	1356.	1349.	1921.	1499.	1521.	2001.
401 TO 410	1185.	1013.	1226.	96.	2249.	826.	1135.	2740.	1118.	999.
411 TO 420	1598.	1951.	685.	1056.	680.	1063.	568.	546.	984.	146.
421 TO 430	599.	612.	992.	220.	719.	1345.	234.	286.	1040.	596.
431 TO 440	505.	1060.	434.	896.	757.	677.	853.	2493.	1180.	2288.

ALT C NO CONSERVATION - 1990 ABAG PROJECTION 3 BC 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	94.745	52.324	71.122	9.137	20.250	232.577
CONTRA COSTA	60.472	75.659	36.587	8.155	13.850	183.388
MARIN	17.183	35.770	4.538	3.471	5.841	62.661
NAPA	6.188	9.520	6.486	1.645	2.597	24.494
SAN FRANCISCO	28.868	4.663	52.339	9.162	5.132	96.404
SAN MATEO	46.317	37.047	27.661	5.357	3.686	117.119
SANTA CLARA	115.991	99.039	73.855	21.676	23.347	316.189
SOLANO	26.726	35.293	12.177	15.029	4.456	88.408
SONOMA	20.582	40.872	11.064	4.918	5.371	78.020

ALT 0 NO CONSERVATION - 1990 ABAG PROJECTION 3 BC 1

TOTAL IN 1000S OF GALLONS PER DAY

440 ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	1059.	1109.	2824.	3266.	3790.	2555.	2563.	831.	1433.	3861.
11 TO 20	827.	1002.	1161.	1362.	3251.	3010.	997.	4401.	1499.	2055.
21 TO 30	1470.	1160.	934.	1994.	4059.	1881.	1618.	2485.	3735.	4550.
31 TO 40	4490.	5875.	22233.	11323.	5945.	2530.	934.	490.	1068.	622.
41 TO 50	3443.	7591.	4964.	4469.	4818.	1911.	2013.	1128.	155.	2832.
51 TO 60	1753.	2682.	3242.	8138.	4493.	6832.	4540.	2447.	1563.	2758.
61 TO 70	2597.	1655.	13758.	5921.	8267.	9579.	1719.	1428.	3193.	4670.
71 TO 80	16972.	5660.	1869.	2853.	4575.	832.	4186.	4165.	3088.	2999.
81 TO 90	4671.	5260.	12347.	9551.	3969.	709.	5217.	2225.	7266.	1169.
91 TO 100	2350.	4750.	3693.	4041.	2361.	2474.	1647.	2265.	2941.	3579.
101 TO 110	2492.	3461.	5025.	4544.	2457.	7723.	3992.	3684.	3102.	11559.
111 TO 120	1090.	4052.	3564.	8150.	1879.	1551.	11419.	1914.	1287.	815.
121 TO 130	1267.	1791.	966.	944.	1780.	1461.	1857.	1427.	1742.	1314.
131 TO 140	486.	1050.	2105.	1751.	1151.	1815.	1782.	1492.	1913.	1116.
141 TO 150	8883.	828.	793.	1860.	2675.	2075.	1851.	1338.	856.	2291.
151 TO 160	1460.	3588.	2297.	2231.	2065.	1587.	1861.	1993.	2151.	1712.
161 TO 170	1828.	2290.	342.	1907.	1079.	2141.	726.	1276.	780.	4196.
171 TO 180	1142.	1573.	1952.	2705.	3016.	2307.	3724.	2947.	2492.	813.
181 TO 190	1291.	1457.	1311.	1810.	2872.	2066.	7928.	3087.	5947.	10854.
191 TO 200	4230.	4079.	1917.	7665.	4178.	3839.	748.	2220.	3973.	6383.
201 TO 210	3065.	4078.	4018.	2092.	2400.	1132.	344.	3759.	3474.	979.
211 TO 220	4843.	4135.	3504.	11894.	7749.	1799.	121.	18502.	5723.	18439.
221 TO 230	2980.	1129.	382.	14636.	7707.	10213.	10944.	1930.	5239.	2269.
231 TO 240	3292.	2865.	3102.	2944.	2403.	7473.	879.	3494.	3383.	5696.
241 TO 250	6009.	4189.	2031.	4107.	2877.	2837.	1802.	4075.	4353.	4674.
251 TO 260	2143.	3600.	877.	971.	2382.	4291.	963.	3763.	2219.	1708.
261 TO 270	937.	1280.	1167.	2400.	1853.	2001.	4176.	3182.	3287.	3149.
271 TO 280	1872.	228.	591.	811.	1187.	1507.	900.	3317.	4951.	4197.
281 TO 290	2117.	3697.	3814.	5921.	2823.	2369.	3036.	3349.	2690.	2413.
291 TO 300	11074.	3684.	5184.	4250.	5579.	539.	3019.	6347.	2749.	2099.
301 TO 310	922.	1931.	1026.	12761.	2147.	887.	1083.	1383.	1682.	1492.
311 TO 320	321.	1521.	1826.	468.	2963.	3391.	2456.	3336.	1946.	1477.
321 TO 330	1759.	1647.	1270.	2609.	451.	1007.	1245.	492.	4198.	3623.
331 TO 340	1268.	1306.	2382.	2446.	798.	1441.	2559.	1395.	1125.	539.
341 TO 350	2606.	1417.	2358.	2057.	1648.	12147.	2066.	1557.	830.	1135.
351 TO 360	987.	1053.	200.	731.	731.	1290.	4933.	1844.	1756.	1479.
361 TO 370	2173.	1470.	3551.	598.	2189.	4930.	2146.	2252.	2890.	2046.
371 TO 380	1562.	1491.	1683.	1826.	972.	937.	3089.	585.	2195.	1632.
381 TO 390	1039.	4582.	4151.	1447.	2581.	1498.	2139.	927.	887.	828.
391 TO 400	1754.	617.	1774.	1593.	1327.	1345.	1886.	1457.	1534.	1953.
401 TO 410	1157.	1246.	1367.	197.	2193.	809.	1139.	2715.	1095.	984.
411 TO 420	1520.	1986.	684.	1064.	692.	1092.	564.	558.	920.	171.
421 TO 430	677.	914.	813.	130.	501.	575.	237.	292.	1049.	588.
431 TO 440	565.	1107.	424.	859.	718.	675.	837.	2445.	1188.	2238.

ALT 1 MODERATE DEVICES - ONLY - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	89.616	52.324	71.122	8.937	10.579	241.514
CONTRA COSTA	55.571	75.659	36.587	7.911	7.659	191.299
MARIN	15.987	35.770	4.538	3.402	2.964	66.063
NAPA	5.636	9.524	6.486	1.604	1.249	26.098
SAN FRANCISCO	27.051	4.663	52.339	8.958	3.383	105.372
SAN MATEO	43.906	37.047	27.661	5.241	3.265	122.360
SANTA CLARA	169.031	99.039	73.855	21.168	13.035	337.357
SOLANO	23.551	35.293	12.177	14.398	2.989	102.806
SONOMA	18.237	40.872	11.064	4.755	3.032	82.775

ALT 1 MODERATE DEVICES - ONLY - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

TOTAL IN 1000S OF GALLONS PER DAY

440 ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	1011.	1081.	2799.	3199.	3770.	2[illegible]00.	2543.	870.	1408.	3846.
11 TO 20	819.	986.	1154.	1343.	3227.	2985.	989.	4369.	1482.	2045.
21 TO 30	1450.	1147.	939.	1985.	4037.	1361.	1618.	2440.	3658.	4497.
31 TO 40	4407.	5673.	22327.	11379.	6014.	2559.	937.	500.	1075.	632.
41 TO 50	3458.	7505.	4986.	4538.	4849.	1935.	1948.	1129.	155.	2796.
51 TO 60	1753.	2614.	3243.	8103.	4357.	6857.	5630.	3054.	1954.	3448.
61 TO 70	3310.	2084.	17060.	6763.	9943.	9069.	1758.	1428.	3143.	4359.
71 TO 80	16740.	5665.	1734.	3054.	4624.	843.	4134.	4222.	3090.	2901.
81 TO 90	4669.	50[illegible]5.	11788.	9644.	3863.	755.	5018.	2144.	7071.	1144.
91 TO 100	2305.	4550.	3516.	3819.	2291.	2396.	1606.	2221.	2850.	3703.
101 TO 110	2555.	3527.	5240.	4718.	2589.	7859.	4047.	3840.	3003.	10978.
111 TO 120	1646.	3936.	3402.	7949.	1823.	1601.	11266.	1850.	1246.	795.
121 TO 130	1225.	1736.	936.	914.	1724.	1413.	1818.	1378.	1694.	1294.
131 TO 140	469.	1624.	2142.	1690.	1129.	1753.	1719.	1445.	1867.	1080.
141 TO 150	8805.	816.	775.	1765.	2587.	1998.	1792.	1297.	830.	2233.
151 TO 160	1428.	3371.	2163.	2168.	1994.	1629.	1809.	1933.	2076.	1654.
161 TO 170	1797.	2256.	908.	1822.	1042.	2077.	700.	1153.	774.	4140.
171 TO 180	1121.	1531.	1891.	2622.	2929.	2254.	3606.	2858.	2425.	795.
181 TO 190	1252.	1418.	1270.	1759.	2808.	1995.	7580.	2894.	5815.	10591.
191 TO 200	4142.	3929.	1872.	7434.	3925.	3721.	719.	2070.	3821.	6079.
201 TO 210	2983.	3918.	3894.	1927.	2321.	1[illegible]40.	341.	3667.	3247.	1012.
211 TO 220	4761.	4035.	3308.	12610.	8210.	1925.	123.	18543.	5709.	18238.
221 TO 230	3003.	1128.	384.	14757.	7425.	10159.	10753.	1904.	5225.	2235.
231 TO 240	3297.	2897.	3133.	2974.	2398.	7611.	893.	3537.	3439.	5744.
241 TO 250	6106.	4251.	2550.	3999.	2936.	2397.	1841.	4161.	4456.	4782.
251 TO 260	2197.	3642.	896.	1006.	2437.	4417.	980.	3878.	2280.	1769.
261 TO 270	957.	1316.	1202.	2404.	1905.	2149.	4265.	3259.	3270.	3104.
271 TO 280	1942.	237.	614.	840.	1229.	1563.	931.	3430.	4792.	4050.
281 TO 290	2355.	3627.	3686.	5973.	2841.	2690.	3409.	3275.	2620.	2347.
291 TO 300	11391.	3686.	5170.	4086.	5202.	535.	2854.	6248.	3065.	2338.
301 TO 310	1028.	2169.	1319.	14398.	2182.	914.	1115.	1438.	1722.	1527.
311 TO 320	328.	1569.	1061.	478.	3062.	3501.	2509.	3432.	1976.	1500.
321 TO 330	1794.	1697.	1299.	2681.	458.	1127.	1274.	507.	4205.	3733.
331 TO 340	1308.	1344.	2457.	2490.	815.	1470.	2609.	1403.	1149.	551.
341 TO 350	2601.	1434.	2408.	2100.	1677.	12273.	2102.	1584.	844.	1162.
351 TO 360	1067.	1070.	614.	749.	754.	1343.	5128.	1875.	1785.	1362.
361 TO 370	2195.	1494.	3507.	609.	2213.	5016.	2250.	2417.	3073.	2199.
371 TO 380	1652.	1556.	1756.	1913.	1015.	869.	3889.	618.	2293.	1726.
381 TO 390	1117.	4916.	4448.	1550.	2718.	1582.	2242.	968.	918.	859.
391 TO 400	1834.	641.	1863.	1663.	1396.	1415.	1959.	1516.	1612.	2038.
401 TO 410	1266.	1228.	1387.	212.	2289.	847.	1186.	2910.	1141.	1030.
411 TO 420	1603.	2096.	714.	1121.	733.	1155.	585.	573.	941.	157.
421 TO 430	724.	977.	836.	115.	534.	717.	254.	313.	1119.	627.
431 TO 440	543.	1181.	440.	894.	739.	709.	870.	2547.	1242.	2376.

ALT 2 MAXIMUM DEVICES - ONLY - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	67.372	49.703	71.122	8.735	9.942	226.844
CONTRA COSTA	53.842	70.224	36.587	7.582	7.019	175.254
MARIN	15.489	34.119	4.538	3.284	2.692	60.122
NAPA	5.421	9.143	6.486	1.560	1.131	23.741
SAN FRANCISCO	26.664	4.643	52.339	8.855	3.018	94.857
SAN MATEO	42.778	35.574	27.661	5.115	3.040	114.168
SANTA CLARA	106.245	92.981	73.855	20.483	11.776	305.339
SOLANO	22.614	31.762	12.177	13.592	2.320	82.465
SONOMA	17.434	38.154	11.064	4.501	2.737	73.890

ALT 2 MAXIMUM DEVICES - ONLY - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

TOTAL IN 100.S OF GALLONS PER DAY

-4. ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	881.	993.	2557.	2838.	3488.	2295.	2340.	795.	1298.	3556.
11 TO 20	759.	914.	1077.	1244.	2963.	2724.	910.	4011.	1356.	1892.
21 TO 30	1326.	1640.	883.	1814.	3702.	1720.	1496.	2377.	3149.	4021.
31 TO 40	3887.	4908.	13[illegible]70.	10266.	5500.	2336.	873.	471.	1002.	593.
41 TO 50	3167.	6730.	4542.	4219.	4462.	1810.	1716.	1349.	144.	2528.
51 TO 60	1616.	2267.	2980.	7464.	3975.	6046.	4138.	2230.	1471.	2594.
61 TO 70	252[illegible].	1573.	12111.	4666.	7053.	8965.	1668.	1333.	2757.	3825.
71 TO 80	14302.	5162.	1528.	2741.	3950.	306.	3851.	3925.	2739.	2655.
81 TO 90	4075.	4420.	11378.	8065.	3632.	723.	4510.	1938.	6555.	1098.
91 TO 100	2176.	4046.	3412.	3564.	2130.	2255.	1532.	2132.	2709.	3369.
101 TO 110	2366.	3157.	4825.	4313.	2396.	6371.	3339.	3447.	2841.	10052.
111 TO 120	1566.	3747.	3244.	7394.	1739.	1526.	10843.	1774.	1186.	760.
121 TO 130	1166.	1655.	892.	870.	1642.	1347.	1743.	1310.	1618.	1245.
131 TO 140	442.	977.	1347.	1666.	1083.	1667.	1633.	1377.	1786.	1029.
141 TO 150	8501.	786.	743.	1694.	2462.	1696.	1707.	1236.	792.	2111.
151 TO 160	1342.	3030.	2303.	2069.	1896.	1549.	1727.	1841.	1974.	1573.
161 TO 170	1728.	2171.	661.	1720.	991.	1980.	663.	1035.	747.	3988.
171 TO 180	1677.	1463.	1801.	2499.	2795.	2156.	3434.	2724.	2317.	768.
181 TO 190	1193.	1355.	1209.	1676.	2690.	1776.	6792.	2675.	5559.	10128.
191 TO 200	3968.	3719.	1786.	7057.	3635.	3542.	677.	1898.	3608.	5692.
201 TO 210	2841.	3700.	3784.	1782.	2201.	948.	329.	3480.	2964.	892.
211 TO 220	4521.	3828.	3377.	11113.	7023.	1752.	113.	15853.	4844.	15139.
221 TO 230	2610.	955.	350.	12980.	6586.	3147.	9257.	1713.	4721.	1992.
231 TO 240	2994.	2652.	2863.	2724.	2168.	6938.	821.	3204.	3079.	5038.
241 TO 250	5454.	3828.	2490.	3920.	2692.	2657.	1684.	3813.	4086.	4388.
251 TO 260	2016.	3312.	823.	931.	2237.	4074.	897.	3580.	2097.	1637.
261 TO 270	877.	1214.	1109.	2269.	1757.	1682.	3904.	2911.	2938.	2804.
271 TO 280	1800.	217.	562.	767.	1124.	1519.	848.	3136.	4685.	4016.
281 TO 290	2015.	3569.	3580.	5738.	2725.	2773.	2948.	3217.	2568.	2301.
291 TO 300	10547.	3332.	4574.	3935.	4829.	629.	2710.	6175.	2640.	2013.
301 TO 310	685.	1876.	1569.	12379.	1998.	868.	1059.	1328.	1624.	1444.
311 TO 320	31[illegible].	1491.	1756.	451.	2913.	3285.	2293.	3214.	1859.	1411.
321 TO 330	1692.	1611.	1218.	2542.	431.	966.	1205.	475.	3679.	3500.
331 TO 340	1242.	1255.	2306.	2338.	770.	1388.	2462.	1309.	1083.	520.
341 TO 350	2465.	1346.	2274.	1983.	1578.	10388.	1976.	1488.	794.	1100.
351 TO 360	947.	1057.	581.	709.	716.	1284.	4895.	1755.	1677.	1228.
361 TO 370	2053.	14[illegible]5.	3335.	573.	2073.	4630.	2020.	2201.	2785.	2004.
371 TO 380	1491.	1393.	1572.	1718.	914.	776.	3505.	559.	2054.	1558.
381 TO 390	1018.	4478.	4149.	1410.	2448.	1427.	2014.	857.	819.	766.
391 TO 400	1649.	572.	1704.	1489.	1256.	1274.	1749.	1355.	1450.	1825.
401 TO 410	1079.	1074.	1226.	193.	2050.	759.	1060.	2649.	1021.	924.
411 TO 420	1444.	1891.	539.	1010.	663.	1[illegible]43.	528.	503.	831.	129.
421 TO 430	658.	888.	733.	91.	485.	650.	231.	285.	1316.	570.
431 TO 440	495.	1072.	393.	799.	655.	538.	776.	2278.	1113.	2150.

ALT 3 - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	85.135	49.707	67.566	8.065	9.660	220.134
CONTRA COSTA	52.793	71.076	34.758	7.140	6.957	173.534
MARIN	15.187	33.982	4.311	3.070	2.651	59.262
NAPA	5.354	9.044	6.161	1.447	1.105	23.111
SAN FRANCISCO	25.693	4.430	49.722	8.094	2.904	90.848
SAN MATEO	41.711	35.195	26.278	4.730	2.959	110.872
SANTA CLARA	103.580	94.087	70.162	19.134	11.569	298.583
SOLANO	22.374	33.528	11.568	12.994	2.352	82.816
SONOMA	17.325	38.828	10.511	4.291	2.744	73.700

ALT 3 - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

TOTAL IN 1000.S OF GALLONS PER DAY

NO. ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	900.	952.	2491.	2847.	3355.	2225.	2263.	774.	1253.	3423.
11 TO 20	729.	878.	1027.	1196.	2872.	2557.	880.	3833.	1319.	1820.
21 TO 30	1295.	1021.	854.	1865.	3670.	1092.	1471.	2219.	3326.	4089.
31 TO 40	3857.	4965.	19542.	10242.	5413.	2304.	843.	451.	968.	568.
41 TO 50	3113.	6755.	4488.	4685.	4364.	1742.	1725.	1000.	137.	2476.
51 TO 60	1552.	2315.	2872.	7175.	3858.	6203.	4016.	2178.	1394.	2459.
61 TO 70	2361.	1486.	12169.	4824.	7093.	8747.	1590.	1292.	2844.	3943.
71 TO 80	15144.	5071.	1589.	2608.	3948.	773.	3787.	3869.	2832.	2659.
81 TO 90	4278.	4586.	10302.	8287.	3540.	692.	4599.	1964.	6480.	1048.
91 TO 100	2112.	4170.	3314.	3499.	2099.	2195.	1472.	2035.	2612.	3268.
101 TO 110	2255.	3123.	4025.	4164.	2285.	6937.	3572.	3383.	2751.	10059.
111 TO 120	1568.	3606.	3117.	7284.	1671.	1467.	10324.	1704.	1142.	728.
121 TO 130	1123.	1591.	858.	837.	1580.	1295.	1666.	1263.	1553.	1186.
131 TO 140	430.	939.	1871.	1548.	1034.	1507.	1575.	1324.	1710.	990.
141 TO 150	8068.	748.	711.	1617.	2371.	1331.	1642.	1188.	761.	2046.
151 TO 160	1309.	3689.	1982.	1986.	1828.	1493.	1658.	1772.	1903.	1516.
161 TO 170	1647.	2067.	832.	1670.	955.	1303.	641.	1057.	709.	3794.
171 TO 180	1027.	1403.	1733.	2403.	2684.	2066.	3304.	2619.	2222.	729.
181 TO 190	1147.	1300.	1163.	1612.	2573.	1828.	6946.	2652.	5329.	9705.
191 TO 200	3795.	3600.	1715.	6813.	3597.	3410.	658.	1897.	3501.	5571.
201 TO 210	2734.	3591.	3568.	1766.	2127.	953.	313.	3363.	2976.	877.
211 TO 220	4363.	3697.	3331.	10930.	7116.	1568.	108.	16293.	5018.	16030.
221 TO 230	2639.	991.	337.	12971.	6526.	8929.	9451.	1673.	4593.	1964.
231 TO 240	2898.	2546.	2754.	2614.	2108.	5690.	785.	3133.	3022.	5048.
241 TO 250	5366.	3736.	2397.	3760.	2580.	2546.	1618.	3657.	3916.	4203.
251 TO 260	1931.	3201.	788.	884.	2142.	3882.	861.	3409.	2004.	1555.
261 TO 270	841.	1157.	1356.	2165.	1674.	1301.	3749.	2864.	2874.	2728.
271 TO 280	1707.	208.	540.	739.	1080.	1462.	818.	3015.	4506.	3846.
281 TO 290	1932.	3421.	3460.	5480.	2607.	2052.	2797.	3079.	2463.	2207.
291 TO 300	10012.	3240.	4544.	3842.	4891.	598.	2683.	5874.	2515.	1919.
301 TO 310	843.	1780.	1492.	11814.	1977.	828.	1011.	1276.	1560.	1384.
311 TO 320	297.	1422.	1086.	433.	2774.	3172.	2274.	3110.	1791.	1359.
321 TO 330	1025.	1538.	1177.	2429.	415.	330.	1154.	459.	3818.	3382.
331 TO 340	1185.	1218.	2226.	2257.	739.	1332.	2364.	1271.	1042.	499.
341 TO 350	2357.	1299.	2182.	1903.	1520.	11121.	1905.	1435.	764.	1053.
351 TO 360	912.	969.	556.	679.	683.	1217.	4647.	1700.	1618.	1234.
361 TO 370	1989.	1354.	3268.	551.	2005.	4545.	1940.	2083.	2650.	1896.
371 TO 380	1424.	1341.	1514.	1650.	878.	749.	3353.	533.	1977.	1488.
381 TO 390	963.	4239.	3835.	1336.	2344.	1364.	1933.	834.	792.	741.
391 TO 400	1581.	553.	1623.	1434.	1203.	1220.	1689.	1337.	1390.	1757.
401 TO 410	1040.	1058.	1136.	183.	1973.	730.	1022.	2509.	984.	888.
411 TO 420	1382.	1807.	616.	966.	632.	996.	508.	494.	811.	136.
421 TO 430	624.	842.	716.	99.	461.	519.	219.	270.	965.	541.
431 TO 440	468.	1028.	380.	770.	637.	512.	750.	2196.	1070.	2048.

ALT 4

- YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	80.654	47.091	64.010	7.239	9.152	208.146
CONTRA COSTA	50.014	68.093	32.929	6.408	6.500	164.044
MARIN	14.388	32.193	4.084	2.756	2.512	55.933
NAPA	5.072	8.568	5.837	1.299	1.047	21.823
SAN FRANCISCO	24.346	4.197	47.105	7.264	2.751	85.663
SAN MATEO	39.515	33.342	24.895	4.245	2.803	104.801
SANTA CLARA	95.128	89.135	66.470	17.146	13.961	281.840
SOLANO	21.195	31.764	10.959	11.652	2.228	77.809
SONOMA	15.413	36.785	9.958	3.852	2.600	69.607

- YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

TOTAL IN 1000S OF GALLONS PER DAY

44. ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	650.	908.	2353.	2689.	3169.	2101.	2138.	731.	1184.	3233.
11 TO 20	688.	829.	970.	1129.	2713.	2509.	832.	3672.	1246.	1719.
21 TO 30	1224.	964.	807.	1707.	3470.	1599.	1391.	2037.	3144.	3866.
31 TO 40	3640.	4686.	18442.	9679.	5115.	2177.	797.	425.	914.	537.
41 TO 50	2941.	5383.	4241.	3860.	4124.	1646.	1629.	944.	130.	2338.
51 TO 60	1406.	2186.	2712.	6775.	3643.	5963.	3747.	2032.	1301.	2294.
61 TO 70	2203.	1387.	11352.	4501.	6617.	8268.	1503.	1221.	2688.	3727.
71 TO 80	14314.	4793.	1503.	2458.	3721.	731.	3582.	3659.	2678.	2515.
81 TO 90	4046.	4338.	10216.	7838.	3348.	654.	4349.	1858.	6129.	991.
91 TO 100	1998.	3944.	3134.	3309.	1985.	2076.	1392.	1925.	2470.	3085.
101 TO 110	2129.	2939.	4366.	3931.	2157.	6549.	3372.	3200.	2602.	9514.
111 TO 120	1426.	3411.	2948.	6889.	1580.	1388.	9764.	1612.	1080.	689.
121 TO 130	1662.	1505.	811.	792.	1494.	1224.	1570.	1194.	1468.	1121.
131 TO 140	406.	868.	1770.	1464.	978.	1020.	1490.	1253.	1618.	936.
141 TO 150	7631.	708.	672.	1530.	2242.	1732.	1553.	1124.	720.	1935.
151 TO 160	1238.	2922.	1975.	1879.	1728.	1412.	1568.	1675.	1800.	1434.
161 TO 170	1558.	1955.	787.	1579.	903.	1860.	606.	1003.	670.	3588.
171 TO 180	972.	1327.	1039.	2272.	2539.	1354.	3125.	2477.	2102.	689.
181 TO 190	1085.	1229.	1180.	1524.	2434.	1729.	6565.	2508.	5048.	9179.
191 TO 200	3589.	3465.	1622.	6443.	3402.	3225.	623.	1794.	3311.	5269.
201 TO 210	2586.	3396.	3375.	1670.	2012.	901.	296.	3178.	2814.	827.
211 TO 220	4127.	3497.	2867.	10309.	6712.	1574.	102.	15383.	4736.	15130.
221 TO 230	2491.	936.	318.	12243.	6160.	8428.	8321.	1579.	4335.	1854.
231 TO 240	2735.	2403.	2599.	2467.	1990.	6314.	741.	2934.	2853.	4765.
241 TO 250	5065.	3526.	2270.	3560.	2436.	2403.	1527.	3451.	3697.	3967.
251 TO 260	1823.	3021.	743.	834.	2022.	3064.	813.	3217.	1892.	1468.
261 TO 270	794.	1092.	997.	2044.	1580.	1700.	3539.	2704.	2713.	2575.
271 TO 280	1611.	197.	510.	697.	1020.	1380.	772.	2846.	4267.	3642.
281 TO 290	183[illegible].	3230.	3276.	5183.	2465.	2508.	2630.	2916.	2333.	2090.
291 TO 300	9450.	3058.	4289.	3638.	4631.	566.	2541.	5553.	2365.	1804.
301 TO 310	793.	1674.	1403.	11110.	1869.	783.	955.	1226.	1475.	1308.
311 TO 320	281.	1344.	1594.	469.	2622.	2999.	2149.	2943.	1693.	1284.
321 TO 330	1536.	1453.	1112.	2296.	392.	679.	1091.	434.	3681.	3197.
331 TO 340	1120.	1151.	2164.	2133.	698.	1259.	2235.	1202.	984.	472.
341 TO 350	2228.	1228.	2062.	1799.	1436.	10012.	1801.	1356.	722.	996.
351 TO 360	862.	915.	526.	641.	646.	1150.	4392.	1666.	1529.	1167.
361 TO 370	1880.	1279.	3089.	521.	1895.	4296.	1829.	1965.	2498.	1787.
371 TO 380	1343.	1265.	1428.	1555.	828.	706.	3162.	532.	1864.	1403.
381 TO 390	968.	3997.	3516.	1260.	2210.	1286.	1823.	787.	747.	698.
391 TO 400	1491.	521.	1531.	1352.	1135.	1151.	1592.	1232.	1311.	1657.
401 TO 410	980.	999.	1128.	172.	1861.	588.	964.	2366.	928.	837.
411 TO 420	1303.	1704.	581.	911.	596.	939.	479.	466.	765.	128.
421 TO 430	588.	794.	575.	93.	434.	583.	207.	254.	910.	510.
431 TO 440	441.	960.	358.	727.	600.	577.	707.	2071.	1009.	1931.

ALT 5

- YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	67.212	39.243	53.341	5.027	7.526	172.449
CONTRA COSTA	41.678	56.744	27.441	4.450	5.500	135.814
MARIN	11.990	26.828	3.403	1.914	2.093	46.228
NAPA	4.227	7.140	4.864	.902	.872	18.005
SAN FRANCISCO	23.288	3.498	39.254	5.045	2.292	73.377
SAN MATEO	32.933	27.785	20.745	2.948	2.336	86.744
SANTA CLARA	81.773	74.279	55.391	11.907	9.134	232.485
SOLANO	17.604	26.470	9.133	8.099	1.857	63.221
SONOMA	13.677	30.654	8.298	2.675	2.157	57.471

ALT 5 - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

TOTAL IN 1000S OF GALLONS PER DAY

44. ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	702.	750.	1343.	2221.	2616.	1735.	1765.	604.	977.	2669.
11 TO 20	568.	685.	801.	932.	2240.	2072.	687.	3032.	1029.	1419.
21 TO 30	1010.	796.	568.	1413.	2874.	1325.	1152.	1737.	2604.	3202.
31 TO 40	2998.	3859.	15189.	8004.	4230.	1300.	659.	351.	756.	444.
41 TO 50	2432.	5279.	3507.	3192.	3410.	1361.	1344.	779.	107.	1929.
51 TO 60	1209.	1804.	2238.	5590.	3006.	4852.	2977.	1615.	1033.	1823.
61 TO 70	1750.	1102.	9320.	3576.	5257.	6842.	1244.	1011.	2224.	3084.
71 TO 80	11846.	3906.	1246.	2016.	3053.	506.	2970.	3033.	2220.	2085.
81 TO 90	3355.	3597.	5471.	6499.	2776.	542.	3606.	1540.	5081.	822.
91 TO 100	1656.	3270.	2599.	2744.	1646.	1722.	1154.	1596.	2048.	2544.
101 TO 110	1755.	2423.	3600.	3241.	1779.	5399.	2780.	2638.	2158.	7889.
111 TO 120	1183.	2828.	2445.	5712.	1310.	1150.	8096.	1336.	895.	571.
121 TO 130	881.	1248.	673.	657.	1239.	1015.	1387.	993.	1218.	938.
131 TO 140	337.	736.	1467.	1214.	811.	1260.	1235.	1339.	1341.	776.
141 TO 150	6327.	587.	557.	1268.	1859.	1436.	1288.	932.	597.	1605.
151 TO 160	1026.	2423.	1555.	1558.	1433.	1171.	1300.	1389.	1492.	1189.
161 TO 170	1292.	1621.	652.	1309.	749.	1492.	503.	823.	556.	2975.
171 TO 180	806.	1100.	1359.	1884.	2105.	1620.	2591.	2054.	1743.	571.
181 TO 190	900.	1019.	912.	1264.	2018.	1434.	5447.	2080.	4179.	7611.
191 TO 200	2976.	2823.	1345.	5342.	2820.	2574.	516.	1488.	2746.	4368.
201 TO 210	2144.	2816.	2798.	1385.	1668.	747.	245.	2635.	2333.	680.
211 TO 220	3422.	2900.	2377.	8476.	5519.	1294.	84.	12677.	3903.	12469.
221 TO 230	2053.	771.	262.	10089.	5076.	6946.	7351.	1301.	3572.	1528.
231 TO 240	2254.	1980.	2142.	2033.	1040.	5204.	610.	2418.	2351.	3927.
241 TO 250	4174.	2906.	1389.	2963.	2007.	1980.	1259.	2844.	3046.	3269.
251 TO 260	1582.	2490.	613.	688.	1666.	3019.	670.	2651.	1559.	1209.
261 TO 270	654.	900.	821.	1684.	1302.	1401.	2916.	2228.	2235.	2122.
271 TO 280	1328.	162.	420.	574.	840.	1137.	636.	2345.	3551.	3030.
281 TO 290	1523.	2687.	2726.	4298.	2044.	2080.	2144.	2426.	1941.	1739.
291 TO 300	7788.	2520.	3535.	3027.	3854.	471.	2114.	4629.	1928.	1470.
301 TO 310	646.	1364.	1144.	9054.	1547.	548.	791.	993.	1221.	1083.
311 TO 320	232.	1112.	1319.	339.	2171.	2482.	1779.	2433.	1401.	1063.
321 TO 330	1271.	1203.	921.	1900.	324.	728.	903.	359.	2981.	2646.
331 TO 340	927.	953.	1742.	1765.	578.	1042.	1850.	995.	815.	390.
341 TO 350	1844.	1017.	1707.	1489.	1189.	8701.	1490.	1123.	598.	824.
351 TO 360	714.	758.	435.	531.	534.	952.	3635.	1333.	1266.	966.
361 TO 370	1556.	1059.	2557.	431.	1569.	3256.	1503.	1614.	2053.	1468.
371 TO 380	1103.	1039.	1173.	1278.	680.	580.	2598.	413.	1531.	1153.
381 TO 390	740.	3283.	2971.	1035.	1816.	1057.	1498.	646.	613.	574.
391 TO 400	1225.	428.	1258.	1111.	932.	345.	1308.	1012.	1077.	1361.
401 TO 410	805.	820.	326.	142.	1529.	565.	792.	1944.	762.	688.
411 TO 420	1070.	1400.	477.	749.	490.	771.	394.	383.	628.	105.
421 TO 430	483.	653.	554.	76.	357.	479.	170.	239.	747.	419.
431 TO 440	363.	789.	294.	597.	493.	474.	581.	1701.	829.	1587.

ALT 6 - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	44.808	26.162	53.341	2.565	5.951	132.827
CONTRA COSTA	27.786	37.830	27.441	2.186	4.081	99.322
MARIN	7.993	17.885	3.403	.888	1.455	31.625
NAPA	2.818	4.760	4.864	.461	.659	13.572
SAN FRANCISCO	13.525	2.332	39.254	2.940	2.004	60.055
SAN MATEO	21.953	18.524	20.745	1.477	1.756	64.455
SANTA CLARA	54.515	49.519	55.391	5.331	6.855	172.272
SOLANO	11.776	17.646	9.133	3.932	1.344	43.831
SONOMA	9.118	20.436	8.298	1.271	1.549	40.672

TOTAL IN 1000'S OF GALLONS PER DAY

440 ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	487.	537.	1303.	1472.	1784.	1376.	1174.	415.	669.	1783.
11 TO 20	396.	470.	671.	680.	1514.	1485.	469.	2071.	693.	952.
21 TO 30	681.	537.	452.	940.	1923.	907.	764.	1155.	1734.	2129.
31 TO 40	2029.	2645.	10112.	5843.	2983.	1347.	463.	305.	563.	374.
41 TO 50	1754.	3729.	2429.	2277.	2656.	1163.	1004.	585.	97.	1520.
51 TO 60	968.	1192.	1562.	4007.	2637.	3457.	1985.	1315.	678.	1247.
61 TO 70	1514.	841.	5768.	2268.	3565.	4849.	1076.	824.	1614.	2159.
71 TO 80	8072.	2908.	690.	1680.	2046.	438.	2068.	2207.	1474.	1498.
81 TO 90	2317.	2406.	5368.	4456.	2179.	372.	2520.	1044.	3669.	583.
91 TO 100	1117.	2214.	1781.	2012.	1107.	1195.	806.	1436.	1414.	1745.
101 TO 110	1168.	1607.	2380.	2304.	1370.	3346.	1885.	2055.	1596.	6070.
111 TO 120	893.	2565.	1777.	4128.	954.	956.	7683.	998.	613.	455.
121 TO 130	620.	858.	460.	447.	890.	685.	1137.	706.	1004.	863.
131 TO 140	269.	535.	1139.	869.	720.	922.	880.	788.	1125.	595.
141 TO 150	6198.	553.	510.	1170.	1406.	1011.	908.	642.	413.	1095.
151 TO 160	698.	1747.	1190.	1177.	1600.	827.	979.	958.	1088.	852.
161 TO 170	1174.	1482.	467.	926.	542.	1140.	349.	572.	551.	2767.
171 TO 180	708.	893.	1005.	1347.	1598.	1332.	1841.	1467.	1342.	455.
181 TO 190	632.	753.	530.	933.	1750.	1003.	4016.	1418.	3088.	6973.
191 TO 200	2263.	2313.	934.	4323.	2071.	1923.	372.	1062.	2156.	3758.
201 TO 210	1645.	2336.	2025.	1047.	1343.	501.	238.	1984.	1610.	511.
211 TO 220	2552.	2035.	1741.	5649.	3607.	943.	68.	8720.	2619.	8225.
221 TO 230	1571.	506.	172.	6748.	3412.	4706.	4839.	958.	2557.	1176.
231 TO 240	1624.	1321.	1450.	1360.	1129.	3450.	441.	1643.	1591.	2593.
241 TO 250	2920.	1943.	1456.	2457.	1427.	1437.	903.	2032.	2268.	2460.
251 TO 260	1213.	1941.	430.	637.	1206.	2570.	457.	2258.	1254.	1097.
261 TO 270	550.	714.	681.	1314.	1191.	1087.	2111.	1547.	1587.	1556.
271 TO 280	1240.	113.	314.	382.	553.	750.	419.	1545.	2719.	2585.
281 TO 290	1236.	2458.	1956.	2867.	1365.	1417.	1770.	2120.	1589.	1430.
291 TO 300	7377.	1965.	2589.	2077.	2639.	466.	1501.	4502.	1396.	1044.
301 TO 310	462.	1160.	862.	7819.	1040.	556.	671.	715.	900.	798.
311 TO 320	172.	768.	944.	250.	1597.	1309.	1223.	1687.	956.	731.
321 TO 330	891.	1053.	807.	1505.	236.	512.	694.	261.	2023.	2238.
331 TO 340	528.	641.	1274.	1208.	422.	747.	1396.	690.	594.	290.
341 TO 350	1349.	699.	1241.	1058.	807.	5081.	1025.	774.	411.	674.
351 TO 360	514.	524.	340.	432.	464.	937.	3508.	981.	883.	671.
361 TO 370	1211.	788.	1780.	320.	1087.	2376.	1209.	1555.	1850.	1431.
371 TO 380	952.	794.	896.	1015.	538.	423.	2168.	380.	1196.	997.
381 TO 390	728.	3172.	2869.	991.	1546.	947.	1252.	514.	447.	420.
391 TO 400	1060.	304.	1119.	854.	799.	311.	1004.	755.	855.	1036.
401 TO 410	606.	575.	665.	137.	1179.	443.	606.	1846.	591.	555.
411 TO 420	903.	1209.	385.	653.	436.	589.	350.	382.	530.	108.
421 TO 430	473.	638.	551.	80.	349.	476.	164.	202.	558.	314.
431 TO 440	349.	742.	227.	531.	361.	400.	467.	1343.	670.	1432.

ALT 7 - YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	83.003	47.218	67.566	7.856	9.445	215.088
CONTRA COSTA	51.150	66.712	34.758	6.843	6.668	166.131
MARIN	14.715	32.413	4.311	2.954	2.557	56.960
NAPA	5.150	8.686	6.161	1.408	1.075	22.480
SAN FRANCISCO	24.704	4.411	49.722	7.931	2.857	89.694
SAN MATEO	40.639	33.795	26.278	4.616	2.888	108.217
SANTA CLARA	100.932	88.332	70.162	18.486	11.187	289.099
SOLANO	21.483	30.174	11.568	12.257	2.234	77.696
SONOMA	16.563	36.246	10.511	4.062	2.600	69.982

ALT 7

- YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

TOTAL IN 100.S OF GALLONS PER DAY

440 ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	835.	940.	2422.	2688.	3304.	2174.	2216.	754.	1230.	3368.
11 TO 20	719.	865.	1020.	1178.	2806.	2580.	862.	3799.	1285.	1792.
21 TO 30	1256.	985.	837.	1720.	3509.	1531.	1418.	1959.	2985.	3812.
31 TO 40	3678.	4702.	18146.	9728.	5212.	2208.	827.	446.	950.	562.
41 TO 50	3001.	6377.	4304.	3998.	4228.	1715.	1625.	993.	137.	2394.
51 TO 60	1530.	2147.	2021.	7068.	3764.	5730.	3872.	2143.	1376.	2428.
61 TO 70	2358.	1472.	11333.	4360.	6599.	8497.	1581.	1261.	2613.	3626.
71 TO 80	13556.	4853.	1544.	2591.	3733.	765.	3652.	3722.	2598.	2518.
81 TO 90	3865.	4197.	3843.	7649.	3444.	586.	4277.	1838.	6217.	1034.
91 TO 100	2058.	3837.	3236.	3380.	2020.	2138.	1453.	2022.	2570.	3189.
101 TO 110	2183.	2988.	4568.	4083.	2268.	5599.	3161.	3263.	2694.	9533.
111 TO 120	1485.	3554.	3076.	7013.	1649.	1447.	16284.	1683.	1125.	721.
121 TO 130	1106.	1569.	846.	825.	1557.	1278.	1653.	1243.	1534.	1181.
131 TO 140	419.	926.	1846.	1523.	1027.	1581.	1549.	1306.	1694.	976.
141 TO 150	8063.	746.	705.	1606.	2335.	1798.	1619.	1172.	751.	2002.
151 TO 160	1273.	2874.	1900.	1962.	1798.	1470.	1538.	1746.	1872.	1492.
161 TO 170	1639.	2059.	817.	1631.	940.	1878.	629.	984.	789.	3783.
171 TO 180	1021.	1388.	1709.	2370.	2651.	2045.	3257.	2584.	2197.	721.
181 TO 190	1132.	1285.	1147.	1590.	2551.	1584.	6442.	2537.	5273.	9598.
191 TO 200	3763.	3527.	1594.	6693.	3447.	3360.	642.	1803.	3422.	5398.
201 TO 210	2694.	3509.	3513.	1690.	2088.	899.	312.	3301.	2811.	844.
211 TO 220	4288.	3630.	2318.	10511.	6642.	1557.	187.	15005.	4585.	14329.
221 TO 230	2470.	904.	331.	12285.	6234.	8658.	8762.	1627.	4468.	1886.
231 TO 240	2834.	2510.	2710.	2579.	2052.	6567.	777.	3033.	2915.	4768.
241 TO 250	5162.	3624.	2364.	3722.	2548.	2515.	1594.	3615.	3867.	4153.
251 TO 260	1908.	3135.	779.	882.	2117.	3856.	849.	3389.	1985.	1549.
261 TO 270	830.	1149.	1050.	2147.	1663.	1781.	3695.	2755.	2781.	2654.
271 TO 280	1703.	2[illegible]6.	532.	726.	1064.	1438.	803.	2968.	4449.	3813.
281 TO 290	1913.	3389.	3399.	5443.	2585.	2530.	2780.	3055.	2438.	2185.
291 TO 300	9983.	3153.	4424.	3737.	4585.	597.	2573.	5864.	2490.	1898.
301 TO 310	835.	1770.	1480.	11675.	1894.	323.	1004.	1259.	1539.	1369.
311 TO 320	294.	1413.	1064.	428.	2761.	3114.	2174.	3046.	1762.	1337.
321 TO 330	1604.	1527.	1154.	2469.	408.	915.	1142.	452.	3487.	3318.
331 TO 340	1177.	1190.	2186.	2216.	730.	1315.	2334.	1241.	1027.	493.
341 TO 350	2280.	1276.	2155.	1880.	1496.	10416.	1873.	1411.	753.	1043.
351 TO 360	898.	955.	550.	672.	679.	1217.	4640.	1674.	1590.	1104.
361 TO 370	1946.	1332.	3218.	543.	1965.	4389.	1911.	2082.	2633.	1895.
371 TO 380	1410.	1317.	1486.	1624.	864.	733.	3314.	528.	1942.	1474.
381 TO 390	963.	4234.	3829.	1333.	2315.	1350.	1904.	820.	774.	724.
391 TO 400	1559.	541.	1611.	1408.	1187.	1205.	1653.	1281.	1371.	1726.
401 TO 410	1020.	1015.	1159.	183.	1938.	718.	1002.	2505.	965.	874.
411 TO 420	1365.	1788.	605.	955.	627.	986.	499.	475.	786.	122.
421 TO 430	622.	840.	693.	86.	459.	514.	219.	269.	961.	539.
431 TO 440	468.	1013.	372.	755.	620.	503.	734.	2154.	1052.	2033.

ALT 8

- YEAR 1990 - ABAG SERIES 3 PROJ., B.C. 1

ALL USES IN MGD

	INSIDE RES. USE	OUTSIDE RES. USE	IND/COMM USE	PUBLIC AUTH. USE	UNACCOUNTED FOR	TOTAL
ALAMEDA	78.635	44.733	64.010	7.051	8.948	203.376
CONTRA COSTA	48.458	63.201	32.929	6.142	6.317	157.046
MARIN	13.940	30.707	4.084	2.650	2.423	53.814
NAPA	6.879	6.229	5.837	1.263	1.018	21.226
SAN FRANCISCO	23.404	4.178	47.105	7.172	2.715	84.575
SAN MATEO	38.500	32.017	24.895	4.143	2.735	102.291
SANTA CLARA	95.620	83.683	66.470	16.591	10.598	272.961
SOLANO	20.353	28.586	10.959	11.009	2.088	72.995
SONOMA	15.691	34.338	9.958	3.646	2.464	66.096

TOTAL IN 100'S OF GALLONS PER DAY

440 ZONE	1	2	3	4	5	6	7	8	9	10
1 TO 10	788.	888.	2287.	2538.	3120.	2053.	2093.	712.	1161.	3181.
11 TO 20	679.	817.	963.	1112.	2656.	2437.	814.	3588.	1213.	1693.
21 TO 30	1186.	930.	791.	1626.	3318.	1542.	1341.	1862.	2822.	3604.
31 TO 40	3471.	4437.	17330.	9192.	4925.	2086.	782.	421.	898.	531.
41 TO 50	2836.	6026.	4067.	3778.	3995.	1621.	1535.	938.	129.	2260.
51 TO 60	1445.	2027.	2664.	6674.	3554.	5416.	3612.	1999.	1284.	2265.
61 TO 70	2200.	1373.	10572.	4068.	6156.	9031.	1494.	1191.	2470.	3427.
71 TO 80	12812.	4625.	1461.	2442.	3518.	723.	3454.	3520.	2457.	2382.
81 TO 90	3656.	3970.	9309.	7235.	3258.	549.	4045.	1738.	5880.	978.
91 TO 100	1947.	3629.	3060.	3197.	1911.	2022.	1374.	1912.	2430.	3011.
101 TO 110	2061.	2821.	4312.	3855.	2141.	6230.	2984.	3081.	2548.	9016.
111 TO 120	1465.	3361.	2310.	6632.	1560.	1369.	9726.	1592.	1064.	682.
121 TO 130	1046.	1484.	800.	781.	1473.	1209.	1564.	1175.	1451.	1117.
131 TO 140	397.	876.	1746.	1440.	971.	1496.	1465.	1235.	1602.	923.
141 TO 150	7626.	705.	666.	1519.	2209.	1701.	1531.	1103.	710.	1894.
151 TO 160	1204.	2718.	1797.	1856.	1701.	1390.	1550.	1651.	1770.	1411.
161 TO 170	1550.	1947.	773.	1542.	889.	1776.	595.	931.	670.	3577.
171 TO 180	966.	1313.	1616.	2241.	2507.	1934.	3080.	2444.	2078.	682.
181 TO 190	1070.	1216.	1085.	1504.	2413.	1593.	6093.	2400.	4987.	9077.
191 TO 200	3559.	3336.	1562.	6330.	3260.	3177.	508.	1703.	3237.	5166.
201 TO 210	2548.	3319.	3323.	1598.	1975.	851.	296.	3122.	2659.	796.
211 TO 220	4656.	3434.	2760.	9913.	6265.	1563.	101.	14163.	4328.	13525.
221 TO 230	2331.	854.	313.	11596.	5884.	8172.	8270.	1536.	4218.	1780.
231 TO 240	2675.	2369.	2558.	2434.	1937.	5198.	733.	2862.	2751.	4501.
241 TO 250	4872.	3420.	2238.	3525.	2405.	2374.	1504.	3412.	3650.	3920.
251 TO 260	1801.	2959.	735.	832.	1999.	3540.	801.	3199.	1874.	1462.
261 TO 270	784.	1084.	991.	2627.	1570.	1081.	3488.	2600.	2625.	2505.
271 TO 280	1608.	194.	502.	685.	1004.	1357.	758.	2801.	4213.	3611.
281 TO 290	1811.	3209.	3219.	5148.	2445.	2488.	2615.	2893.	2309.	2869.
291 TO 300	9423.	2976.	4176.	3538.	4342.	566.	2437.	5553.	2341.	1785.
301 TO 310	785.	1664.	1392.	10979.	1790.	778.	949.	1190.	1455.	1294.
311 TO 320	278.	1336.	1573.	464.	2610.	2343.	2055.	2879.	1665.	1264.
321 TO 330	1510.	1443.	1091.	2277.	386.	365.	1079.	427.	3296.	3136.
331 TO 340	1113.	1124.	2066.	2095.	690.	1243.	2206.	1173.	971.	466.
341 TO 350	2155.	1200.	2037.	1777.	1414.	9845.	1771.	1333.	712.	986.
351 TO 360	849.	902.	520.	635.	642.	1150.	4386.	1582.	1502.	1100.
361 TO 370	1840.	1259.	3042.	514.	1857.	4148.	1801.	1963.	2483.	1787.
371 TO 380	1330.	1242.	1402.	1532.	815.	591.	3125.	498.	1831.	1389.
381 TO 390	908.	3992.	3610.	1257.	2183.	1273.	1795.	773.	730.	683.
391 TO 400	1470.	510.	1519.	1327.	1120.	1136.	1559.	1203.	1293.	1627.
401 TO 410	962.	957.	1093.	172.	1827.	677.	945.	2362.	910.	824.
411 TO 420	1288.	1686.	570.	900.	591.	930.	471.	448.	741.	115.
421 TO 430	587.	792.	553.	81.	432.	579.	206.	254.	906.	508.
431 TO 440	441.	956.	351.	712.	584.	569.	692.	2031.	992.	1917.

WQ/Tech Memo 15/May 31,77
Revised June 8,77
Peter Y. Chiu

WATER QUALITY MANAGEMENT PLANS

ESTIMATED MUNICIPAL AND NON-DISCRETE

INDUSTRIAL WASTEWATER LOADS

IN THE SAN FRANCISCO BAY REGION

TECHNICAL MEMORANDUM NO. 15

June 8, 1977

The purpose of this technical memorandum is to estimate the pollutant loads from municipal and non-discrete industrial wastewater in the 208 planning area. Treated wastewater (effluent) loads are estimated at a five year interval from 1975 to 2000. A summary of these estimates is presented in the following table. Detailed estimates for each sewerage unit are presented in Tables 1 to 6. Boundaries of the sewerage units are shown in Figure 1. In most cases, these boundaries are identical to those indicated in Figure 15-2 of the Water Quality Control Plan Report, San Francisco Bay Basin (Basin Plan).

It should be noted that waste loads from Sewerage Units 51 to 58 are not estimated since there are no significant wastewater discharges in those areas.

Summary of Estimated Municipal and Non-Discrete Industrial Wastewater Loads after Treatment

Population and Wastewater Loads*	1975	1980	1985	1990	1995	2000
Total Populátion (S.U. 1 to 59)	4,611,076	4,835,582	5,092,889	5,352,824	5,591,416	5,798,984
Sewered Population (S.U. 1 to 50)*	4,536,600	4,747,268	4,978,868	5,200,928	5,389,258	5,514,997
Average Dry Weather Flow (ADWF), in million gallons per day (mgd)	536	602	632	666	691	706
Biochemical Oxygen Demand (BOD_5), in pounds per day (ppd)	397,800	103,900	108,500	113,800	117,700	120,300
Total Suspended Solids (TSS), in pounds per day (ppd)	244,600	103,500	108,100	113,400	117,400	120,100
Total Nitrogen (TN), in pounds per day (ppd)	126,100	128,500	134,400	141,000	146,100	149,300
Total Phosphorus (TP), in pounds per day (ppd)	71,100	83,300	88,100	92,900	96,200	97,900
Ammonia Nitrogen ($N\text{-}NH_3$), in pounds per day (ppd)	81,600	62,200	64,700	67,700	69,800	71,300

* Excluding Sewerage Units 51 to 59

Based on the above summary, the following conclusions can be drawn:

- In the future, the Bay Area population served by municipal wastewater treatment facilities, will remain at about 97% of the total population.
- The wastewater flow will increase as population increases.
- Certain pollutant loads, such as organic matters, suspended solids, and ammonia nitrogen will decrease in the near future as better treatment for the wastewater is achieved.
- After the year 1980, the pollutant loads will steadily increase as the wastewater flow increases.

In general, the estimates were prepared in the following manner.

<u>For the 1975 estimates</u>

- The domestic and industrial flow data were obtained from the 201 project reports and environmental impact documents. Additional information on domestic flow was obtained from the summary of the self-monitoring program reports compiled by the Regional Water Quality Control Board (RWQCB) staff.
- The population served by municipal wastewater treatment facilities was estimated on the basis of ABAG's Series 3 projections.
- The unit flow rate (in gallons per capita per day) was then calculated on the basis of the estimated domestic flow and sewered population.
- The treated wastewater (effluent) quality data (in milligrams per liter) for biochemical oxygen demand, total suspended solids, total nitrogen, total phosphorus, and ammonia nitrogen were obtained from the self-monitoring report summary compiled by the RWQCB. In a few instances, effluent quality was estimated by ABAG staff.
- The pollutant loads were then calculated on the basis of the estimated flow and the reported effluent quality data.

<u>For the 1980 to 2000 estimates</u>

- The population served by municipal wastewater treatment facilities was estimated on the basis of ABAG's Series 3 projections.
- The unit flow rate (in gallons per capita per day) was obtained from the 201 project reports.
- The domestic flow was then calculated on the basis of the population projections and the unit flow rate.

- The average dry weather flow was calculated by adding the previously calculated domestic flow to the estimated industrial flow given in the 201 projected reports.

- The unit effluent loadings (in milligrams per liter) for biochemical oxygen demand and total suspended solids were estimated on the basis that the treated wastewater would have the same level of effluent quality as the monthly average required by the RWQCB. In most cases, the required quality would be 30 milligrams per liter for both biochemical oxygen demand and total suspended solids. It should be noted that the annual average load will be somewhat less than the monthly average.

- The unit effluent loadings (in milligrams per liter) for total nitrogen, total phosphorus, and ammonia nitrogen were estimated on the basis that the unit loadings of the treatment plant would be similar to the 1975 loadings of a comparable treatment plant.

- The pollutant loads were then calculated on the basis of the estimated flow and the unit loadings.

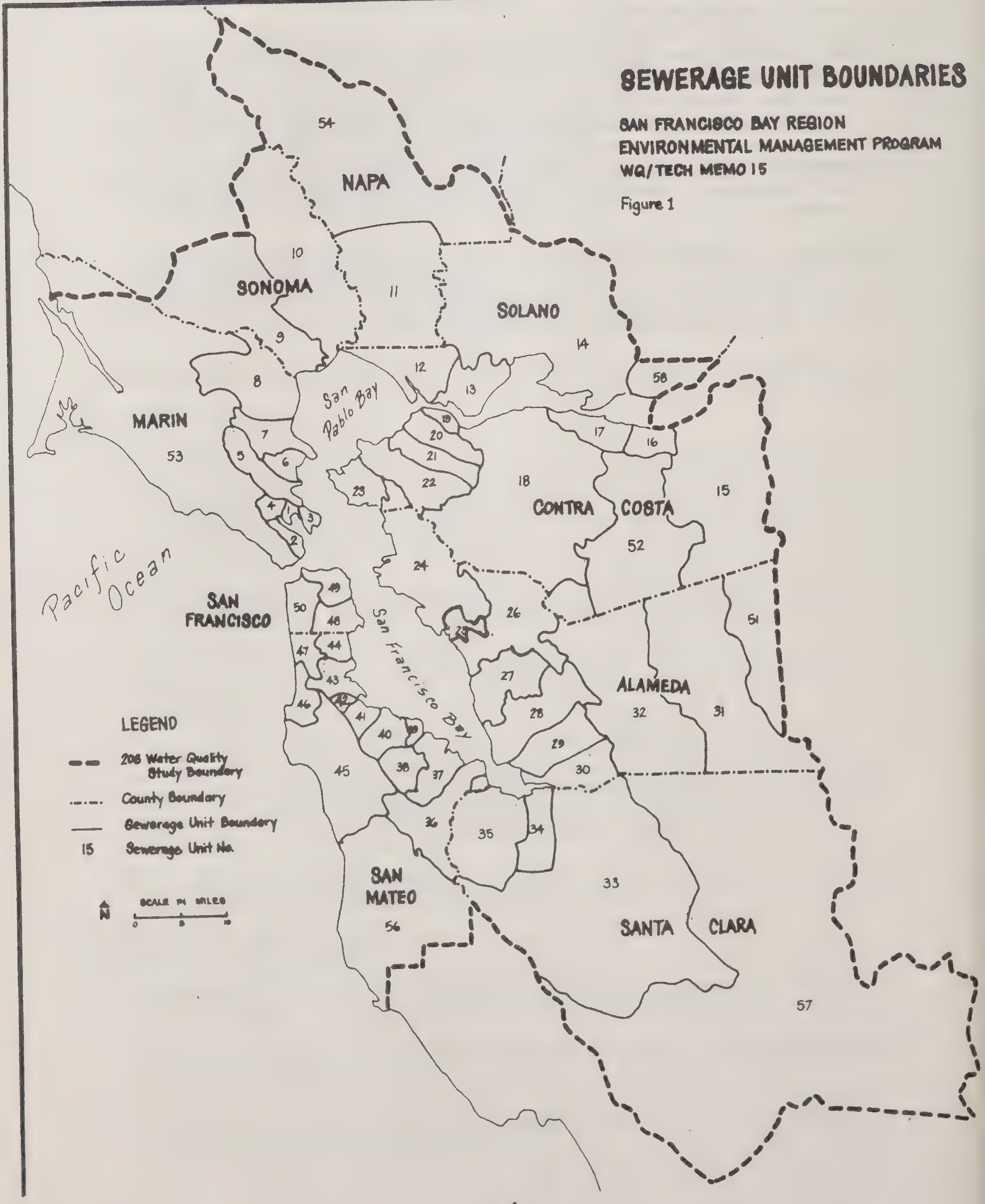

SEWERAGE UNIT BOUNDARIES
SAN FRANCISCO BAY REGION
ENVIRONMENTAL MANAGEMENT PROGRAM
WQ/TECH MEMO 15
Figure 1
NAPA
SONOMA
SOLANO
MARIN
San Pablo Bay
CONTRA COSTA
Pacific Ocean
SAN FRANCISCO
San Francisco Bay
ALAMEDA
SAN MATEO
SANTA CLARA
LEGEND
208 Water Quality Study Boundary
County Boundary
Sewerage Unit Boundary
15 Sewerage Unit No.
SCALE IN MILES
0 5 10

Table 1. Estimated Municipal and Non-Discrete Wastewater Loads After Treatment in 1975 (Base Year)

Sewerage Unit	Population Served	Domestic Flow gpcd	Domestic Flow mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	8240	97.1	.8	0.0	.8	11	73	20	133	35	234	24	160	24	160
2. Sausalito	13572	83.3	1.1	0.0	1.1	160	1508	67	631	31	292	6	57	24	226
3. Tiburon	7772	84.9	.7	0.0	.7	130	716	80	440	23	127	30	165	15	83
4. Mill Valley	17498	93.2	1.6	0.0	1.6	14	190	19	258	52	707	24	326	24	326
5. Ross Valley	53576	85.1	4.6	0.0	4.6	50	1902	32	1217	21	799	8	304	14	532
6. San Rafael-San Quentin	33123	132.5	4.4	0.0	4.4	32	1172	31	1135	35	1281	14	513	29	1062
7. Las Gallinas-Marin Bay	27990	75.4	2.1	0.0	2.1	27	475	29	510	35	616	27	475	32	563
8. Novato-Hamilton	43469	84.2	3.7	0.0	3.7	15	458	20	610	26	794	6	183	20	610
9. Petaluma	36148	101.3	3.7	0.0	3.7	52	1587	100	3052	30	916	21	641	25	763
10. Sonoma Valley	18993	101.6	1.9	0.0	1.9	24	386	20	322	30	483	21	338	25	402
11. Napa-American Canyon	54136	99.7	5.4	.3	5.7	22	1046	65	3090	10	475	5	238	1	48
12. Vallejo-Mare Island	73180	99.8	7.3[a]	.5	7.8[a]	140	9107	125	8131	33	2147	13	846	22	1431
13. Benecia	7573	87.2	.7	.3	1.0	110	917	64	534	42	350	7	58	17	142
14. Fairfield-Suisun-Travis	56993	94.7	7.4[a]	1.7	9.1[a]	22	1670	61	4630	22	1670	11	835	14	1063
15. East County*	7614	78.8	.6	0.0	.6	120	600	100	500	35	175	30	150	25	125
16. Antioch	33735	75.3	2.5	.1	2.6	71	1540	40	867	24	520	5	108	16	347
17. CCCSD 7A & 7B	33656	101.6	3.4	.5	4.0	111	3657	65	2141	26	857	6	198	18	593
18. Central CCCSD-Mt. View	315592	103.0	32.5	0.0	32.5	97	26292	70	18973	30	8131	20	5421	20	5421
19. Crockett-Port Costa	3790	68.6	.3	0.0	.3	208	451	62	134	27	59	9	20	16	35
20. Rodeo	6723	104.1	.7	0.0	.7	6	35	18	105	23	134	12	70	3	18
21. Pinole-Hercules	13374	97.2	1.3	0.0	1.3	7	76	21	228	34	369	12	130	5	54
22. San Pablo	58667	97.2	5.7	.3	6.0	4	200	5	250	24	1201	14	701	19	951
23. Richmond	51986	86.6	4.5	.9	5.4	19	856	37	1666	24	1081	29	1306	12	540
24. EBMUD	578274	112.9	65.3	11.3	76.6	210	134157	86	54941	36	22998	10	6388	20	12777
25. San Leandro	46483	71.0	3.3	3.4	6.7	22	1229	41	2291	5	279	45	2515	2	112
26. Oro Loma-Castro Valley	135258	94.6	12.8	.5	13.3	17	1886	33	3660	27	2995	44	4881	20	2218
27. Hayward	102329	93.8	9.6	1.7	11.3	55	5183	120	11309	21	1979	4	377	11	1037
28, 29, 30. Union-Newark-Fremont	175236	79.9	14.0	1.8	15.8	64	8433	63	8302	30	3953	40	5271	22	2899
31. Livermore	48348	88.1	4.3	.3	4.6	10	382	12	458	25	955	10	382	1	38
32. VCSD-Pleasanton	59019	87.9	5.2	.1	5.3	10	441	6	265	31	1368	25	1103	1	44
33. San Jose-Santa Clara	845606	93.4	79.0	13.4	92.4	30	23118	24	18495	24	18495	22	16954	18	13871
34. Sunnyvale	105862	100.1	10.6	5.7	16.3	28	3806	72	9788	28	3806	21	2855	18	2447
35. Palo Alto	176847	119.3	21.1	6.9	28.0	19	4437	16	3736	27	6305	6	1401	24	5604
36. Menlo Park	50842	96.4	4.9	.6	5.5	17	780	15	688	30	1376	22	1009	26	1193
37. Redwood City	77245	93.2	7.2	1.0	8.2	195	13336	86	5881	32	2188	18	1231	20	1368
38. San Carlos-Belmont	51758	96.6	5.0	1.0	6.0	120	6005	78	3903	44	2202	18	901	15	751
39. Estero	22554	88.7	2.0	0.0	2.0	120	2002	70	1168	35	584	7	117	20	334
40. San Mateo	82131	127.8	10.5	0.0	10.5	116	10158	80	7006	36	3153	28	2452	21	1839
41. Burlingame	31674	138.9	4.4	.4	4.8	34	1361	34	1361	31	1241	5	200	25	1001
42. Millbrae	21533	111.5	2.4	0.0	2.4	15	300	20	400	30	600	22	440	26	520
43. SSF-Airport-San Bruno	79500	106.9	8.5	1.3	9.8	65	5313	21	1716	21	1716	4	327	16	1308
44. Guadalupe Valley**	22678	90.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	11316	88.4	1.0	0.0	1.0	120	1001	71	592	40	334	38	317	12	100
46. Pacifica	38245	91.5	3.5	0.0	3.5	140	4087	85	2481	38	1109	12	350	29	847
47. N. San Mateo	70354	66.8	4.7	0.0	4.7	210	8232	124	4861	39	1529	38	1490	28	1098
48. Southeast	157938	78.5	12.4	4.5	20.5	160	27355	78	13336	34	5813	7	1197	21	3590
49. North Point	306452	65.9	20.2	4.9	62.1	98	50756	49	25378	23	11912	8	4143	14	7251
50. Richmond-Sunset	208250	65.8	13.7	1.2	23.3	150	29148	67	13020	30	5830	8	1555	20	3886
TOTALS (S.U. 1-50)	4536600		420	67	536		397819		244597		126137		71096		81627

Table 2. Estimated Municipal and Non-Discrete Wastewater Loads After Treatment in1980

Sewerage Unit	Population Served	Domestic Flow gpcd	Domestic Flow mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	10108	85.0	.9	0.0	.9	30	215	30	215	30	215	20	143	20	143
2. Sausalito	15216	90.0	1.4	0.0	1.4	30	343	30	343	30	343	20	228	20	228
3. Tiburon	7891	100.0	.8	0.0	.8	30	197	30	197	30	197	20	132	20	132
4. Mill Valley	17538	85.0	1.5	0.0	1.5	30	373	30	373	30	373	20	249	20	249
5. Ross Valley	54808	85.0	4.7	0.0	4.7	30	1166	30	1166	30	1166	20	777	20	777
6. San Rafael-San Quentin	33353	122.0	4.1	0.0	4.1	30	1018	30	1018	30	1018	20	679	20	679
7. Las Gallinas-Marin Bay	28528	80.0	2.3	0.0	2.3	30	571	30	571	30	571	20	381	20	381
8. Novato-Hamilton	50489	90.0	4.5	0.0	4.5	30	1137	30	1137	30	1137	20	758	20	758
9. Petaluma	46246	100.0	4.6	0.0	4.6	30	1157	30	1157	30	1157	20	771	20	771
10. Sonoma Valley	20410	100.0	2.0	0.0	2.0	30	511	30	511	30	511	20	340	20	340
11. Napa-American Canyon	54453	100.0	5.4	.3	5.7	5	240	15	719	10	479	5	240	3	144
12. Vallejo-Mare Island	76250	100.0	7.6[a]	.5	8.1[a]	30	2033	30	2033	30	2033	15	1016	20	1355
13. Benecia	9840	85.0	.8	.4	1.2	30	309	30	309	30	309	10	103	15	155
14. Fairfield-Suisun-Travis	66129	100.0	8.6[a]	3.1	11.7[a]	10	977	10	977	20	1954	20	1954	3	293
15. East County*	7715	85.0	.7	0.0	.7	30	164	30	164	20	109	10	55	15	82
16. Antioch	33985	80.0	2.7	.1	2.8	30	700	30	700	20	467	10	233	15	350
17. CCCSD 7A & 7B	34553	85.0	2.9	.9	3.9	30	973	30	973	20	648	10	324	15	486
18. Central CCCSD-Mt. View	346798	103.0[b]	35.7	0.0	35.7	2	596	1	298	2	596	10	2979	2	596
19. Crockett- Port Costa	3840	100.0	.4	0.0	.4	30	96	30	96	30	96	10	32	15	48
20. Rodeo	11060	100.0	1.1	0.0	1.1	30	277	30	277	20	184	10	92	10	92
21. Pinole-Hercules	18417	100.0	1.8	0.0	1.8	30	461	30	461	30	461	10	154	15	230
22. San Pablo	63011	100.0	6.3	.4	6.7	30	1684	30	1684	25	1403	15	842	15	842
23. Richmond	52141	100.0	5.2	1.8	7.0	30	1757	30	1757	25	1465	30	1757	15	879
24. EBMUD	583519	113.0	65.9	11.3	77.2	30	19325	30	19325	30	19325	10	6442	20	12883
25. San Leandro	45165	80.3	3.6	3.5	7.1	30	1783	30	1783	20	1189	40	2377	10	594
26. Oro Loma-Castro Valley	135800	90.1	12.2	.5	12.7	30	3186	30	3186	25	2655	40	4249	20	2124
27. Hayward	115193	102.0	11.7	1.7	13.4	30	3365	30	3365	20	2243	10	1122	10	1122
28, 29,30. Union-Newark-Fremont	197071	78.5	15.5	2.3	17.8	30	4446	30	4446	30	4446	40	5928	20	2964
31. Livermore	50255	93.2	4.7	.3	5.0	30	1247	30	1247	30	1247	30	1247	20	831
32. VCSD-Pleasanton	70589	90.0	6.4	1.3	7.7	30	1915	30	1915	30	1915	30	1915	20	1277
33. San Jose-Santa Clara	907923	100.0	90.8	41.8	132.6	10	11058	10	11058	25	27645	20	22116	3	3317
34. Sunnyvale	105027	100.0	10.5	10.3	20.8	10	1735	10	1735	25	4337	20	3470	3	520
35. Palo Alto	175423	100.0	18.5[c]	6.9	25.4	10	2122	10	2122	25	5305	10	2122	3	637
36. Menlo Park	50745	85.7	5.3[c]	.6	5.9	10	496	8	397	30	1488	20	992	10	496
37. Redwood City	76452	89.7	7.7[d]	1.0	8.7	10	722	8	578	30	2166	20	1444	10	722
38. San Carlos-Belmont	51333	83.3	4.3	1.0	5.3	10	440	8	352	30	1320	20	880	10	440
39. Estero	23843	80.0	2.1[e]	0.0	2.1	10	176	8	141	30	527	20	352	20	352
40. San Mateo	81913	100.0	9.9[f]	0.0	9.9	10	825	8	660	30	2475	20	1650	20	1650
41. Burlingame	30858	100.0	3.1	.4	3.5	30	872	30	872	30	872	10	291	20	581
42. Millbrae	21164	100.0	2.1	0.0	2.1	30	530	30	530	30	530	20	353	20	353
43. SSF-Airport-San Bruno	78823	92.0	8.3[g]	1.3	9.6	30	2390	30	2390	20	1593	5	398	15	1195
44. Guadalupe Valley**	26318	90.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	12870	85.0	1.4[j]	0.0	1.4	30	349	30	349	30	349	30	349	15	174
46. Pacifica	42674	85.0	3.6	0.0	3.6	30	908	30	908	30	908	15	454	20	605
47. N. San Mateo	77663	94.0	7.3	0.0	7.3	30	1827	30	1827	30	1827	30	1827	20	1218
48. Southeast	156194	0.0	13.0[m]	4.4	23.7[i]	30	5930	30	5930	30	5930	10	1977	20	3953
49. North Point	301216	0.0	20.5	4.7	64.2[i]	30	16063	30	16063	30	16063	10	5354	20	10709
50. Richmond-Sunset	210571	0.0	14.3	1.2	20.9[i]	30	5229	30	5229	30	5229	10	1743	20	3486
TOTALS (S.U. 1-50)r	4747268		449	102	602		103891		103541		128476		83290		62215

Table 3. Estimated Municipal and Non-Discrete Wastewater Loads After Treatment in 1985

Sewerage Unit	Population Served	Domestic gpcd	Flow mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	11466	85.0	1.0	0.0	1.0	30	244	30	244	30	244	20	163	20	163
2. Sausalito	16841	90.0	1.5	0.0	1.5	30	379	30	379	30	379	20	253	20	253
3. Tiburon	8614	100.0	.9	0.0	.9	30	216	30	216	30	216	20	144	20	144
4. Mill Valley	17745	85.0	1.5	0.0	1.5	30	377	30	377	30	377	20	252	20	252
5. Ross Valley	56194	85.0	4.8	0.0	4.8	30	1195	30	1195	30	1195	20	797	20	797
6. San Rafael-San Quentin	33727	122.0	4.1	0.0	4.1	30	1029	30	1029	30	1029	20	686	20	686
7. Las Gallinas-Marin Bay	29559	80.0	2.4	0.0	2.4	30	592	30	592	30	592	20	394	20	394
8. Novato-Hamilton	55781	90.0	5.0	0.0	5.0	30	1256	30	1256	30	1256	20	837	20	837
9. Petaluma	51563	100.0	5.2	0.0	5.2	30	1290	30	1290	30	1290	20	860	20	860
10. Sonoma Valley	21553	100.0	2.2	0.0	2.2	30	539	30	539	30	539	20	360	20	360
11. Napa-American Canyon	54457	100.0	5.4	.3	5.7	5	240	15	719	10	479	5	240	3	144
12. Vallejo-Mare Island	78612	100.0	7.9 a	.5	8.4 a	30	2092	30	2092	30	2092	15	1046	20	1395
13. Benecia	12152	85.0	1.0	.5	1.5	30	384	30	384	30	384	10	128	15	192
14. Fairfield-Suisun-Travis	73998	100.0	9.4 a	6.2	15.6 a	10	1301	10	1301	20	2602	20	2602	3	390
15. East County*	8250	85.0	.7	0.0	.7	30	175	30	175	20	117	10	58	15	88
16. Antioch	34881	80.0	2.8	.1	2.9	30	721	30	721	20	480	10	240	15	360
17. CCCSD 7A & 7B	36154	85.0	3.1	1.1	4.2	30	1044	30	1044	20	696	10	348	15	522
18. Central CCCSD-Mt. View	377801	103.0 b	38.9	0.0	38.9	2	649	1	325	2	649	10	3245	2	649
19. Crockett- Port Costa	3894	100.0	.4	0.0	.4	30	97	30	97	30	97	10	32	15	49
20. Rodeo	16559	100.0	1.7	0.0	1.7	30	414	30	414	20	276	10	138	10	138
21. Pinole-Hercules	25940	100.0	2.6	0.0	2.6	30	649	30	649	30	649	10	216	15	325
22. San Pablo	68767	100.0	6.9	.5	7.4	30	1841	30	1841	25	1534	15	920	15	920
23. Richmond	52144	100.0	5.2	1.9	7.1	30	1770	30	1770	25	1475	30	1770	15	885
24. EBMUD	577380	113.0	65.2	11.3	76.5	30	19151	30	19151	30	19151	10	6384	20	12768
25. San Leandro	43966	80.3	3.5	3.5	7.0	30	1759	30	1759	20	1173	40	2345	10	586
26. Oro Loma-Castro Valley	135819	90.1	12.2	.5	12.7	30	3187	30	3187	25	2656	40	4249	20	2125
27. Hayward	127573	102.0	13.0	1.7	14.7	30	3681	30	3681	20	2454	10	1227	10	1227
28, 29,30.Union-Newark-Fremont	223559	78.5	17.5	2.3	19.8	30	4966	30	4966	30	4966	40	6622	20	3311
31. Livermore	54361	93.2	5.1	.3	5.4	30	1343	30	1343	30	1343	30	1343	20	895
32. VCSD-Pleasanton	88420	90.0	8.0	1.3	9.3	30	2316	30	2316	30	2316	30	2316	20	1544
33. San Jose-Santa Clara	991950	100.0	99.2	42.9	142.1	10	11851	10	11851	25	29627	20	23701	3	3555
34. Sunnyvale	103933	100.0	10.4	10.3	20.7	10	1726	10	1726	25	4315	20	3452	3	518
35. Palo Alto	175766	100.0	18.6 c	6.9	25.5	10	2125	10	2125	25	5312	10	2125	3	637
36. Menlo Park	53087	85.7	5.5 c	.6	6.1	10	513	8	410	30	1539	20	1026	10	513
37. Redwood City	76433	89.7	7.7 d	1.0	8.7	10	722	8	578	30	2166	20	1444	10	722
38. San Carlos-Belmont	52209	83.3	4.3 e	1.0	5.3	10	446	8	357	30	1338	20	892	10	446
39. Estero	24908	80.0	2.2	0.0	2.2	10	183	8	146	30	549	20	366	20	366
40. San Mateo	82844	100.0	10.0 f	0.0	10.0	10	833	8	666	30	2498	20	1665	20	1665
41. Burlingame	30051	100.0	3.0	.4	3.4	30	852	30	852	30	852	10	284	20	568
42. Millbrae	20766	100.0	2.1	0.0	2.1	30	520	30	520	30	520	20	346	20	346
43. SSF-Airport-San Bruno	77176	92.0	8.1 g	1.3	9.4	30	2352	30	2352	20	1568	5	392	15	1176
44. Guadalupe Valley**	28270	90.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	17174	85.0	1.8 j	0.0	1.8	30	440	30	440	30	440	30	440	15	220
46. Pacifica	54360	85.0	4.6	0.0	4.6	30	1156	30	1156	30	1156	15	578	20	771
47. N. San Mateo	80083	94.0	7.5	0.0	7.5	30	1883	30	1883	30	1883	30	1883	20	1256
48. Southeast	151795	0.0	13.0 n	4.3	23.8 i	30	5955	30	5955	30	5955	10	1985	20	3970
49. North Point	294991	0.0	20.5	4.5	66.9 i	30	16738	30	16738	30	16738	10	5579	20	11159
50. Richmond-Sunset	206436	0.0	14.3	1.2	21.1 i	30	5279	30	5279	30	5279	10	1760	20	3519
TOTALS (S.U. 1-50)r	4978868		472	106	632		108471		108087		134442		88135		64665

Table 4. Estimated Municipal and Non-Discrete Wastewater Loads After Trestment in 1990

Sewerage Unit	Population Served	Domestic Flow gpcd	Domestic Flow mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	11503	85.0	1.0	0.0	1.0	30	245	30	245	30	245	20	163	20	163
2. Sausalito	17598	90.0	1.6	0.0	1.6	30	396	30	396	30	396	20	264	20	264
3. Tiburon	8552	100.0	.9	0.0	.9	30	214	30	214	30	214	20	143	20	143
4. Mill Valley	17813	85.0	1.5	0.0	1.5	30	379	30	379	30	379	20	253	20	253
5. Ross Valley	62746	85.0	5.3	0.0	5.3	30	1334	30	1334	30	1334	20	890	20	890
6. San Rafael-San Quentin	34258	122.0	4.2	0.0	4.2	30	1046	30	1046	30	1046	20	697	20	697
7. Las Gallinas-Marin Bay	33951	80.0	2.7	0.0	2.7	30	680	30	680	30	680	20	453	20	453
8. Novato-Hamilton	71139	90.0	6.4	0.0	6.4	30	1602	30	1602	30	1602	20	1068	20	1068
9. Petaluma	56206	100.0	5.6	0.0	5.6	30	1406	30	1406	30	1406	20	938	20	938
10. Sonoma Valley	29109	100.0	2.9	0.0	2.9	30	728	30	728	30	728	20	486	20	486
11. Napa-American Canyon	64055	100.0	6.4	.3	6.7	5	280	15	839	10	559	5	280	3	168
12. Vallejo-Mare Island	83278	100.0	8.3[a]	.5	8.8[a]	30	2209	30	2209	30	2209	15	1104	20	1472
13. Benecia	14460	85.0	1.2	.5	1.7	30	433	30	433	30	433	10	144	15	216
14. Fairfield-Suisun-Travis	84267	100.0	10.4[a]	8.0	18.4[a]	10	1537	10	1537	20	3074	20	3074	3	461
15. East County*	16416	85.0	1.4	0.0	1.4	30	349	30	349	20	233	10	116	15	175
16. Antioch	36876	80.0	3.0	.1	3.1	30	763	30	763	20	509	10	254	15	382
17. CCCSD 7A & 7B	38723	85.0	3.3	1.2	4.5	30	1114	30	1114	20	743	10	371	15	557
18. Central CCCSD-Mt. View	415439	103.0[b]	42.8	0.0	42.8	2	714	1	357	2	714	10	3569	2	714
19. Crockett-Port Costa	3993	100.0	.4	0.0	.4	30	100	30	100	30	100	10	33	15	50
20. Rodeo	18264	100.0	1.8	0.0	1.8	30	457	30	457	20	305	10	152	10	152
21. Pinole-Hercules	28689	100.0	2.9	0.0	2.9	30	718	30	718	30	718	10	239	15	359
22. San Pablo	71468	100.0	7.1	.5	7.6	30	1913	30	1913	25	1594	15	957	15	957
23. Richmond	54399	100.0	5.4	1.9	7.3	30	1836	30	1836	25	1530	30	1836	15	918
24. EBMUD	591000	113.0	66.8	11.3	78.1	30	19536	30	19536	30	19536	10	6512	20	13024
25. San Leandro	45422	80.3	3.6	3.5	7.1	30	1788	30	1788	20	1192	40	2384	10	596
26. Oro Loma-Castro Valley	135762	90.1	12.2	.5	12.7	30	3186	30	3186	25	2655	40	4247	20	2124
27. Hayward	131894	102.0	13.5	1.7	15.2	30	3791	30	3791	20	2528	10	1264	10	1264
28, 29, 30. Union-Newark-Fremont	230631	78.5	18.1	2.3	20.4	30	5105	30	5105	30	5105	40	6807	20	3403
31. Livermore	67241	93.2	6.3	.3	6.6	30	1643	30	1643	30	1643	30	1643	20	1095
32. VCSD-Pleasanton	98018	90.0	8.8	1.3	10.1	30	2532	30	2532	30	2532	30	2532	20	1688
33. San Jose-Santa Clara	1044978	100.0	104.5	43.9	148.4	10	12376	10	12376	25	30941	20	24753	3	3713
34. Sunnyvale	102125	100.0	10.2	13.2	23.4	10	1953	10	1953	25	4882	20	3905	3	586
35. Palo Alto	175806	100.0	18.6[c]	6.9	25.5	10	2125	10	2125	25	5313	10	2125	3	638
36. Menlo Park	52515	85.7	5.5[c]	.6	6.1	10	509	8	407	30	1526	20	1018	10	509
37. Redwood City	75407	89.7	7.6[d]	1.0	8.6	10	714	8	571	30	2143	20	1428	10	714
38. San Carlos-Belmont	51313	83.3	4.3	1.0	5.3	10	440	8	352	30	1320	20	880	10	440
39. Estero	25959	80.0	2.3[e]	0.0	2.3	10	190	8	152	30	570	20	380	20	380
40. San Mateo	84390	100.0	10.1[f]	0.0	10.1	10	846	8	676	30	2537	20	1691	20	1691
41. Burlingame	31518	100.0	3.2	.4	3.6	30	889	30	889	30	889	10	296	20	592
42. Millbrae	20377	100.0	2.0	0.0	2.0	30	510	30	510	30	510	20	340	20	340
43. SSF-Airport-San Bruno	77439	92.0	8.1[g]	1.3	9.4	30	2358	30	2358	20	1572	5	393	15	1179
44. Guadalupe Valley**	33080	90.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	23335	85.0	2.3[j]	0.0	2.3	30	571	30	571	30	571	30	571	15	286
46. Pacifica	60409	85.0	5.1	0.0	5.1	30	1285	30	1285	30	1285	15	642	20	856
47. N. San Mateo	79797	94.0	7.5	0.0	7.5	30	1877	30	1877	30	1877	30	1877	20	1251
48. Southeast	148796	0.0	13.6[o]	4.2	24.5[i]	30	6130	30	6130	30	6130	10	2043	20	4087
49. North Point	295607	0.0	21.0	4.3	70.3[i]	30	17589	30	17589	30	17589	10	5863	20	11726
50. Richmond-Sunset	202840	0.0	14.4	1.2	21.5[i]	30	5379	30	5379	30	5379	10	1793	20	3586
TOTALS (S.U. 1-50)[r]	5200928		496	112	666		113774		113437		140972		92873		67702

Table 5. Estimated Municipal and Non-Discrete Wastewater Loads After Treatment in 1995

Sewerage Unit	Population Served	Domestic Flow gpcd	Domestic Flow mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	11376	85.0	1.0	0.0	1.0	30	242	30	242	30	242	20	161	20	161
2. Sausalito	18176	90.0	1.6	0.0	1.6	30	409	30	409	30	409	20	273	20	273
3. Tiburon	8435	100.0	.8	0.0	.8	30	211	30	211	30	211	20	141	20	141
4. Mill Valley	18774	85.0	1.6	0.0	1.6	30	399	30	399	30	399	20	266	20	266
5. Ross Valley	63363	85.0	5.4	0.0	5.4	30	1348	30	1348	30	1348	20	898	20	898
6. San Rafael-San Quentin	34182	122.0	4.2	0.0	4.2	30	1043	30	1043	30	1043	20	696	20	696
7. Las Gallinas-Marin Bay	33558	80.0	2.7	0.0	2.7	30	672	30	672	30	672	20	448	20	448
8. Novato-Hamilton	83275	90.0	7.5	0.0	7.5	30	1875	30	1875	30	1875	20	1250	20	1250
9. Petaluma	65163	100.0	6.5	0.0	6.5	30	1630	30	1630	30	1630	20	1087	20	1087
10. Sonoma Valley	34996	100.0	3.5	0.0	3.5	30	876	30	876	30	876	20	584	20	584
11. Napa-American Canyon	67851	100.0	6.8	.3	7.1	5	295	15	886	10	591	5	295	3	177
12. Vallejo-Mare Island	97968	100.0	9.8a	.5	10.3[a]	30	2576	30	2576	30	2576	15	1288	20	1718
13. Benecia	17919	85.0	1.5	.6	2.1	30	531	30	531	30	531	10	177	15	266
14. Fairfield-Suisun-Travis	114255	100.0	13.4[a]	8.0	21.4[a]	10	1787	10	1787	20	3574	20	3574	3	536
15. East County*	20736	85.0	1.8	0.0	1.8	30	441	30	441	20	294	10	147	15	220
16. Antioch	47181	80.0	3.8	.1	3.9	30	972	30	972	20	648	10	324	15	486
17. CCCSD 7A & 7B	50596	85.0	4.3	1.2	5.5	30	1384	30	1384	20	923	10	461	15	692
18. Central CCCSD-Mt. View	423006	103.0	43.6	0.0	43.6	2	727	1	363	2	727	10	3634	2	727
19. Crockett-Port Costa	5355	100.0	.5	0.0	.5	30	134	30	134	30	134	10	45	15	67
20. Rodeo	18006	100.0	1.8	0.0	1.8	30	451	30	451	20	300	10	150	10	150
21. Pinole-Hercules	28275	100.0	2.8	0.0	2.8	30	707	30	707	30	707	10	236	15	354
22. San Pablo	70768	100.0	7.1	.5	7.6	30	1901	30	1901	25	1584	15	950	15	950
23. Richmond	54579	100.0	5.5	2.0	7.4	30	1853	30	1853	25	1545	30	1853	15	927
24. EBMUD	613385	113.0	69.3	11.3	80.6	30	20169	30	20169	30	20169	10	6723	20	13446
25. San Leandro	46576	80.3	3.7	3.5	7.2	30	1811	30	1811	20	1208	40	2415	10	604
26. Oro Loma-Castro Valley	134102	90.1	12.1	.5	12.6	30	3148	30	3148	25	2623	40	4198	20	2099
27. Hayward	130116	102.0	13.3	1.7	15.0	30	3746	30	3746	20	2497	10	1249	10	1249
28, 29,30.Union-Newark-Fremont	227240	78.5	17.8	2.3	20.1	30	5039	30	5039	30	5039	40	6718	20	3359
31. Livermore	66221	93.2	6.2	.3	6.5	30	1619	30	1619	30	1619	30	1619	20	1079
32. VCSD-Pleasanton	96540	90.0	8.7	1.4	10.1	30	2524	30	2524	30	2524	30	2524	20	1683
33. San Jose-Santa Clara	1104318	100.0	110.4	45.0	155.4	10	12963	10	12963	25	32408	20	25926	3	3889
34. Sunnyvale	100829	100.0	10.1	16.0	26.1	10	2175	10	2175	25	5438	20	4351	3	653
35. Palo Alto	175155	100.0	18.5c	6.9	25.4	10	2120	10	2120	25	5299	10	2120	3	636
36. Menlo Park	51948	85.7	5.5c	.6	6.1	10	505	8	404	30	1514	20	1009	10	505
37. Redwood City	74515	89.7	7.5d	1.0	8.5	10	708	8	566	30	2123	20	1415	10	708
38. San Carlos-Belmont	50747	83.3	4.2	1.0	5.2	10	436	8	349	30	1308	20	872	10	436
39. Estero	25606	80.0	2.2[e]	0.0	2.2	10	188	8	150	30	563	20	375	20	375
40. San Mateo	84526	100.0	10.2f	0.0	10.2	10	847	8	677	30	2540	20	1693	20	1693
41. Burlingame	32161	100.0	3.2	.4	3.6	30	905	30	905	30	905	10	302	20	603
42. Millbrae	20149	100.0	2.0	0.0	2.0	30	504	30	504	30	504	20	336	20	336
43. SSF-Airport-San Bruno	76973	92.0	8.6[h]	1.3	9.9	30	2472	30	2472	20	1648	5	412	15	1236
44. Guadalupe Valley**	33973	90.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	23032	85.0	2.3j	0.0	2.3	30	565	30	565	30	565	30	565	15	282
46. Pacifica	59567	85.0	5.1	0.0	5.1	30	1267	30	1267	30	1267	15	633	20	845
47. N. San Mateo	79468	94.0	7.5	0.0	7.5	30	1869	30	1869	30	1869	30	1869	20	1246
48. Southeast	147175	0.0	13.5p	4.2	24.6i	30	6155	30	6155	30	6155	10	2052	20	4103
49. North Point	299604	0.0	21.4	4.2	72.3i	30	18089	30	18089	30	18089	10	6030	20	12060
50. Richmond-Sunset	200814	0.0	14.4	1.2	21.7i	30	5429	30	5429	30	5429	10	1810	20	3620
TOTALS (S.U. 1-50)r	5389258		515	116	691		117718		117409		146143		96154		69817

Table 6. Estimated Municipal and Non-Discrete Wastewater Loads After Treatment in 2000

Sewerage Unit	Population served	Domestic Flow gpcd	Domestic Flow mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	11349	85.0	1.0	0.0	1.0	30	241	30	241	30	241	20	161	20	161
2. Sausalito	18818	90.0	1.7	0.0	1.7	30	424	30	424	30	424	20	282	20	282
3. Tiburon	8409	100.0	.8	0.0	.8	30	210	30	210	30	210	20	140	20	140
4. Mill Valley	19749	85.0	1.7	0.0	1.7	30	420	30	420	30	420	20	280	20	280
5. Ross Valley	64454	85.0	5.5	0.0	5.5	30	1371	30	1371	30	1371	20	914	20	914
6. San Rafael-San Quentin	34448	122.0	4.2	0.0	4.2	30	1052	30	1052	30	1052	20	701	20	701
7. Las Gallinas-Marin Bay	33517	80.0	2.7	0.0	2.7	30	671	30	671	30	671	20	447	20	447
8. Novato-Hamilton	82996	90.0	7.5	0.0	7.5	30	1869	30	1869	30	1869	20	1246	20	1246
9. Petaluma	66546	100.0	6.7	0.0	6.7	30	1665	30	1665	30	1665	20	1110	20	1110
10. Sonoma Valley	38369	100.0	3.8	0.0	3.8	30	960	30	960	30	960	20	640	20	640
11. Napa-American Canyon	77411	100.0	7.7	.3	8.0	5	335	15	1006	10	671	5	335	3	201
12. Vallejo-Mare Island	99029	100.0	9.9a	.5	10.4a	30	2603	30	2603	30	2603	15	1301	20	1735
13. Benecia	17854	85.0	1.5	.6	2.1	30	530	30	530	30	530	10	177	15	265
14. Fairfield-Suisun-Travis	125452	100.0	14.5a	8.0	22.5a	10	1880	10	1880	20	3761	20	3761	3	564
15. East County*	40816	85.0	3.5	0.0	3.5	30	868	30	868	20	579	10	289	15	434
16. Antioch	48499	80.0	3.9	.1	4.0	30	998	30	998	20	666	10	333	15	499
17. CCCSD 7A & 7B	50504	85.0	4.3	1.3	5.6	30	1392	30	1392	20	928	10	464	15	696
18. Central CCCSD-Mt. View	423790	103.0b	43.7	0.0	43.7	2	728	1	364	2	728	10	3640	2	728
19. Crockett-Port Costa	5708	100.0	.6	0.0	.6	30	143	30	143	30	143	10	48	15	71
20. Rodeo	17946	100.0	1.8	0.0	1.8	30	449	30	449	20	299	10	150	10	150
21. Pinole-Hercules	28178	100.0	2.8	0.0	2.8	30	705	30	705	30	705	10	235	15	353
22. San Pablo	70847	100.0	7.1	.6	7.7	30	1915	30	1915	25	1596	15	958	15	958
23. Richmond	55296	100.0	5.5	2.0	7.5	30	1884	30	1884	25	1570	30	1884	15	942
24. EBMUD	637417	113.0	72.0	11.3	83.3	30	20849	30	20849	30	20849	10	6950	20	13899
25. San Leandro	47981	80.3	3.9	3.5	7.4	30	1840	30	1840	20	1226	40	2453	10	613
26. Oro Loma-Castro Valley	133816	90.1	12.1	.5	12.6	30	3142	30	3142	25	2618	40	4189	20	2094
27. Hayward	129742	102.0	13.2	1.7	14.9	30	3736	30	3736	20	2491	10	1245	10	1245
28, 29,30. Union-Newark-Fremont	226489	78.5	17.8	2.3	20.1	30	5024	30	5024	30	5024	40	6698	20	3349
31. Livermore	66018	93.2	6.2	.3	6.5	30	1615	30	1615	30	1615	30	1615	20	1076
32. VCSD-Pleasanton	96262	90.0	8.7	1.4	10.1	30	2518	30	2518	30	2518	30	2518	20	1679
33. San Jose-Santa Clara	1137954	100.0	113.8	46.0	159.8	10	13327	10	13327	25	33317	20	26654	3	3998
34. Sunnyvale	100573	100.0	10.1	16.0	26.1	10	2173	10	2173	25	5433	20	4346	3	652
35. Palo Alto	176233	100.0	18.6c	6.9	25.5	10	2129	10	2129	25	5322	10	2129	3	639
36. Menlo Park	51909	85.7	5.4c	.6	6.0	10	504	8	404	30	1513	20	1009	10	504
37. Redwood City	74346	89.7	7.5d	1.0	8.5	10	706	8	565	30	2119	20	1413	10	706
38. San Carlos-Belmont	50648	83.3	4.2	1.0	5.2	10	435	8	348	30	1306	20	871	10	435
39. Estero	25521	80.0	2.2e	0.0	2.2	10	187	8	150	30	561	20	374	20	374
40. San Mateo	85314	100.0	10.2f	0.0	10.2	10	853	8	683	30	2560	20	1707	20	1707
41. Burlingame	32963	100.0	3.3	.4	3.7	30	925	30	925	30	925	10	308	20	617
42. Millbrae	20114	100.0	2.0	0.0	2.0	30	503	30	503	30	503	20	336	20	336
43. SSF-Airport-San Bruno	77219	92.0	8.6h	1.3	9.9	30	2478	30	2478	20	1652	5	413	15	1239
44. Guadalupe Valley**	35005	90.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	22975	85.0	2.3j	0.0	2.3	30	564	30	564	30	564	30	564	15	282
46. Pacifica	59372	85.0	5.0	0.0	5.0	30	1263	30	1263	30	1263	15	631	20	842
47. N. San Mateo	79822	94.0	7.5	0.0	7.5	30	1877	30	1877	30	1877	30	1877	20	1252
48. Southeast	147140	-	13.8g	4.0	24.8i	30	6205	30	6205	30	6205	10	2068	20	4137
49. North Point	305279	-	22.0	4.0	74.6i	30	18665	30	18665	30	18665	10	6222	20	12443
50. Richmond-Sunset	200686	-	14.4	1.2	21.9i	30	5479	30	5479	30	5479	10	1826	20	3653
TOTALS (S.U. 1-50)[r]	5514997		527	117	706		120310		120079		149264		97911		71288

FOOTNOTES FOR TABLES 1 to 6

[a]The flow of S.U. 12 includes 0.6 mgd from Mare Island; the flow of S.U. 14 includes 2.0 mgd from Travis Air Force Base.

[b]Including non-discrete industrial flow.

[c]Including dry weather infiltration flow of 1.0 mgd.

[d]Including dry weather infiltration of 0.8 mgd.

[e]Including dry weather infiltration of 0.2 mgd.

[f]Including dry weather infiltration of 1.7 mgd.

[g]Including 1.0 mgd from SF Airport.

[h]Including 1.5 mgd from SF Airport.

[i]Including flows from employed residents and commuters, tourists, and dry weather infiltration.

[j]Including 0.3 mgd from recreation activities.

[k]Including 2.0 mgd from Guadalupe Valley.

[l]Including flow from canneries.

[m]Including 2.4 mgd from Guadalupe Valley.

[n]Including 2.5 mgd from Guadalupe Valley.

[o]Including 3.0 mgd from Guadalupe Valley.

[p]Including 3.1 mgd from Guadalupe Valley.

[q]Including 3.2 mgd from Guadalupe Valley.

[r]Totals do not include waste loads from sewerage units 51-57.

* Brentwood, Byron, Discovery Bay, Oakley and Bethel Island.

** Tributary to San Francisco Southeast Plant.

WQ/Tech Memo 17/May 1977

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Water Quality Management Plans

Significance of Pollution Problems Resulting From the Extraction of Mineral Resources

Technical Memorandum No. 17
12 May 1977

INTRODUCTION

There are four major types of mineral extraction activities that occur or have occurred in the Bay Area. The activities are, in order of economic importance: (1) surface mining, submarine mining, or quarrying of construction materials, (2) drilling and use of wells for the extraction of energy resources* (oil, gas, and geothermal steam), (3) ponding for evaporation to produce salines, and (4) mining of mercury.**

The California Surface Mining and Reclamation Act of 1975 (SMARA) provides an excellent description of the extent and complexity of just one of these activities when it defines "mined lands" as "the surface, subsurface, and ground water of an area in which surface mining operations will be, are being, or have been conducted, including private ways and roads appurtenant to any such area, land excavations, workings, mining waste, and areas in which structures, facilities, equipment, machines, tools or other materials or property which result from, or are used in, surface mining operations are located."

NATURE OF WATER POLLUTION ASSOCIATED WITH MINERAL RESOURCE EXTRACTION

The extent and type of water quality problems resulting from the extraction of minerals depend on the type of activity and its location. However, the types of pollution can be generalized into two categories. First, the disruption of the land surface results in increased erosion and consequently, an increase in the amount of suspended solids and bed load in streams. The resulting sediment alters fish species composition and population densities, destroys fish habitat, and increases floodwater damage. The increased load

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* Coal has not been mined in the Bay Area since 1904, and is not likely to be mined again (Bailey and Harden, 1975a).

**Mining has not occurred since 1973.

of suspended solids increases the treatment cost of domestic and industrial water supplies. Second, the disruption of the ground and surface water and the concentration of harmful materials in mine wastes can effect the acidity and/or increase the level of dissolved minerals in the affected water, thereby decreasing the usefullness of that water for domestic, industrial or recreational use.

CURRENT AND PROJECTED EXTENT OF THE PROBLEMS

The U.S. Geological Survey, in conjunction with the California Division of Mines and Geology, has mapped the major mineral resources of the Bay Area, (Bailey and Harden, 1975). Table 1 summarizes the major mineral extration activities in this region, the counties in which each occurs, and the annual value of the products (to give an estimate of the relative significance of each activity).

Construction Materials

Because construction materials are a high bulk, low value commodity, quarries, surface mines, and submarine mines are, and will continue to be present near developing urban areas in order to minimize transportation costs.

Sand and gravel deposits usually occur on valley floors where existing streams have been depositing their loads. The mineral content and pH of the nearby streams are not significantly affected by mining these deposits since usable deposits must be physically sound and chemically non-reactive. However, water quality problems can occur. For example, wastewaters resulting from the washing of clay from sand and gravels can produce a sediment problem at the discharge point. Most of the suspended matter can be removed from these wastewaters in settling ponds but, unless the ponds are properly designed, they can clog ground water recharge areas (Bailey and Harden, 1975a). Also, sand deposits occurring in places beneath the Bay and offshore are mined to a limited extent. Although no significant mining has occurred to date, the potential for large scale extraction of the Point Knox-Alcatraz-Presidio shoals and parts of the Golden Gate bar west of the Golden Gate Bridge might have a significant effect on water quality (Bailey and Harden, 1975a).

Quarrying and crushing of rock can increase erosion, rock falls, and other types of down slope movement that contribute to the sediment load in streams. Proper precautions taken to prevent stream pollution would include diverting surface runoff away from quarry areas and capturing and settling runoff originating from quarry areas.

Limestone is currently quarried only near Cupertino. Because of its calcium carbonate content, water running through the deposits can become slightly alkaline. This same quality can be useful in neutralizing acidic waste water, the more common problem. Therefore, water supply treatment plants rarely complain about treating this type of water.

TABLE 1: MAJOR MINERAL EXTRACTION

ACTIVITIES IN THE BAY AREA *

Mineral Resource	Type of Operation	Location (By County)	Approximate Value Annually
onstruction Materials			$70 million per year
Sand & Gravel	Surface mine Submarine mine	Alameda, Napa, San Francisco, Santa Clara, Solano, Sonoma	
Crushed Stone	Quarry	Alameda, Contra Costa, Marin, Napa, San Mateo, Santa Clara, Solano, Sonoma	
Limestone	Quarry Submarine mine	Alameda, San Mateo, Santa Clara	
nergy Resources			$30 million per year
Coal	Surface mine	Contra Costa (stopped)	
Geothermal	Well	Sonoma	
Oil and Gas	Well	Contra Costa, Solano	
alines	Pond	Alameda, Napa, San Mateo, Santa Clara, Solano	$16 million per year
ercury	Underground mine Quarry	Santa Clara (has not been mined since 1973)	Fluctuates ($110 million total to date)

* Adapted from Bailey and Harden, 1975.

Water pollution problems from the mining of construction materials are not significant at this time. Mining operations are subject to specific Waste Discharge Requirements established by the San Francisco Bay Area Regional Water Quality Control Board under the authority of the Porter-Cologne Act. Mine operators must file self-monitoring reports with the RWQCB. These reports, although not totally comprehensive in nature, do not indicate any significant water pollution problems.

Energy Sources

Natural gas and some oil are currently the most valuable energy sources in the Bay Area. However, the reserves are expected to be depleted in less than 20 years. Geothermal steam is expected to increase greatly in importance. Coal and peat, although present in limited amounts in the Bay Area, are not expected to be extracted since they are not economically competitive with other energy sources (Bailey and Harden, 1975a). Water percolating through coal mines, such as those near Mt. Diablo, tends to become highly acidic and could carry large amounts of heavy metals. However, no serious problem of this type exists in the Mt. Diablo vicinity (Johnston, 1977).

Extraction of oil, gas, and steam all require the drilling and use of deep wells. Drilling practices are closely regulated by the California Division of Oil and Gas. Drilling involves a fair amount of disruption of the land surface since "roads must be provided for access, a drill rig must be erected, ponds for retention of drilling fluids must be dug, and storage tanks and other temporary structures are generally required" (Bailey and Harden, 1975a). After the drilling has been completed, however, the structures can be removed, the ponds regraded, and most of the land returned to its condition prior to drilling. The actual well heads are small and can be concealed easily.

Salines

Salt is obtained by evaporating Bay water in shallow ponds now covering approximately 35,000 acres of marshland. These ponds are currently concentrated in the southern Bay, with a few ponds located in the northern Bay. The amount of marshland used for this purpose is likely to decrease in the future because of the value of these lands for recreation, wildlife habitat, development, and waste disposal. The existing salt ponds in the southern Bay are considered compatible with the Wildlife Refuge established in that area in 1972 (Bailey and Harden, 1975a).

The only possible problem associated with these ponds is the way in which the highly concentrated bittern liquid remaining after the commercial salts have been extracted is to be stored or disposed. As of 1977, Leslie Salt Co., by far the largest producer in the Bay Area, is storing the bittern. It is a highly toxic solution, but its toxicity is apparently only due to its concentration. Ultimately, there are two possible means of disposal: (1) diffusion and discharge through the proposed treated sewage effluent outfall of the

South Bay Dischargers Authority, or (2) diffusion and discharge near the existing ponds. The State Department of Fish and Game is opposed to the latter because of possible toxic levels of salts at the discharge point. If the pipeline is built, Leslie Salt will use this method of discharge; if it is not built, the staff of the Regional Water Quality Control Board will recommend allowing the second means of disposal (Kolb, 1977).

Mercury

The Santa Clara Valley Water District has closed Almaden, Calero and Guadalupe Reservoirs in Santa Clara County to fishing because of toxic levels of mercury contained in the fish. Because these reservoirs are part of the water supply of Santa Clara County, the District has monitored the mercury concentrations in the lakes and the ground water. No toxic levels of mercury have been found in these waters. The District staff believe that most of the mercury is associated with the sediments in the lakes rather than the water.

The source of the mercury contamination is believed to be the New Almaden Mining District located in the hills above the reservoirs. There are many shafts and tunnels that were excavated to obtain the mercury ore (chiefly cinnabar). Many tailing piles and dumps also occur in this area. The tailings were produced by the cinnabar processing that took place near the location of the mining activities that have been occurring in this area since 1850.

According to Bailey and Harden (1975a), the cinnabar is "quite insoluable in normal waters." They continue:

> It is doubtful that mercury mining has anywhere raised the natural mercury content of streams flowing from the areas, though the processing of the ore to recover the metal might result in stream contamination. Mercury metal, in contrast to the sulfide (cinnabar ore), can contaminate, and the drainage of water through a dump of rock that has been put through an improperly adjusted furnace could be a source of mercury pollution....Similarly, the mercury exhaust gases from an improperly operated condensing system would cause air pollution, and even ground and (surface) water pollution if in sufficient quantity to settle out...

The staff of the Santa Clara Valley Water District does not anticipate that the water quality will deteriorate further due to drainage through existing tailings. Even if further contamination should occur, the precise source of the contamination would be virtually impossible to isolate. The majority of the contamination may have occurred many years ago since mining and processing has been occuring in this area since 1824. The District staff believes that

attempting to remove the existing mercury laden sediments in the reservoirs would cause more water quality problems than it would solve. If the mines in the New Almaden area reopen*, newly enacted EPA controls placing severe restrictions on the amounts of mercury that can be discharged to the water** or air*** should avoid any further mercury pollution due to new processing operations (Bailey and Harden, 197a).

Copper

Although little processing and mining is currently occurring in this region, slag heaps from processing near Benecia were thought to be a major source of copper contamination. Copper levels in waters near these processing areas had been more than 100 times the water quality criteria levels (SWRCB, RWQCB, 1974). These slag heaps were sealed in 1972 against the leaching that had been occurring by both rainwater and runoff and no future problems should develop (Johnston, 1977).

REGULATORY SETTING

Mining activities in the Bay Area are subject to a variety of Federal, State and local regulations designed to protect the environment. It appears that these regulations (and laws) are sufficient to protect mining wastes from becoming a significant water pollutant source.

Federal

The Environmental Protection Agency has two regulations dealing with the handling of mining wastes: Effluent Guidelines and Standards for Mineral Mining and Processing, (40 CFR 436); and Effluent Guidelines and Standards for Ore Mining and Dressing, (40 CFR 440). These guidelines provide maximum effluent limitation guidelines for the following subcategories of minerals and ores: crushed stone, construction sand and gravel, industrial

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* The mines have been closed since 1973.

** These controls have been passed in response to Sections 301 and 304 of the Federal Water Pollution Control Act Amendments of 1972 (PL92-500) and are contained in the EPA Effluent Guidelines and Standards for Ore Mining and Dressing (Sections 440.60-440.62).

*** These controls have been passed in response to Section 112 of the Federal Clean Air Amendments of 1970 (PL91-604). They are contained in Regulation 8 of the Bay Area Air Pollution Control District.

sand, gypsum, asphaltic minerals, asbestos and wallostonite, barite, fluorspar, salines from brine lakes, borax, potash, iron ore, bore and precious metals, baurite, ferroalloys, uranium, mercury and titanium. Mining waste dischargers are subject to the NPDES permit system, which in the State of California is administered through the Regional Water Quality Control Boards.

The EPA effluent guidelines pertinent to existing Bay Area mining activities are:

• crushed stone, construction sand and gravel	total suspended solids of 30 mg/l, pH of 6.0 to 9.0

State and Local

Various laws are available at the state level to control mining wastes. Water pollution control is accomplished through the provisions of the Porter-Cologne Act which defines beneficial uses to be protected and the Federal Water Pollution Control Act Amendments which established effluent limits and a permitting procedure for discharges to navigable waters.

Additionally, the California Health and Safety Code (Div. 26, Part 1, Chapter 6), authorizes local air pollution control districts to enforce emission standards for airborne mercury, which rapidly finds its way to surface water.

The Surface Mining and Reclamation Act of 1975 requires local governments to obtain reclamation plans from mining operators prior to issuing a mining permit. Of special note is the requirement in SMARA that a reclamation plan include: (1) "a description of the manner in which contaminants will be controlled, and mining waste will be disposed; and (2) a description of the manner in which rehabilitation of affected streambed channels and streambeds to a condition minimizing erosion and sedimentation will occur." The cities and counties are required to have staff members conduct periodic inspection of these operations to ensure that the requirements of SMARA are enforced. Because SMARA has just begun operation, its effectiveness cannot be evaluated adequately at the present time. Even in Alameda County, where the largest operations in the Bay Area are located, no reclamation plans have been prepared to date (Carpenter, 1977).

While this act requires statements of interest and methodology to prevent water pollution, its principal focus is land reclamation and protection of land for future uses. It can thus be expected that the burden of water quality protection will fall to the San Francisco Bay Regional Water Quality Control Board, through the NPDES permit system. The RWQCB would work with the counties in coordinating SMARA and Porter-Cologne Act requirements.

SUMMARY OF REGIONAL SIGNIFICANCE

Current Federal and State water pollution regulations, together with the State Surface Mining and Reclamation Act, should provide adequate control of water pollution resulting from the extraction of mineral resources. There is no documentation of significant water pollution from current mining operations. Therefore, it must be concluded that mining activities do not pose a water quality problem of significance in the San Francisco Bay region. This conclusion is based upon the results of mining industry self-monitoring programs, with inherent weaknesses in accuracy and reliability and an untested new law (SMARA). Therefore, the following section presents a recommended action.

RECOMMENDATION

The effectiveness of SMARA and of the self-monitoring programs conducted for the RWQCB should be monitored and assessed as part of the continuing planning process. If the present system is found to be insufficiently effective, additional means of ensuring adequate enforcement of existing regulations should be developed and implemented, or new regulations proposed.

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APPENDIX A: MAJOR STATUTES AND REGULATIONS AFFECTING MINERAL EXTRACTION ACTIVITIES

Existing Statute or Regulation	Administering Agency	Regulated Extraction Activities	Summary of Provisions
FEDERAL			
Federal Water Pollution Control Act Amendments of 1972 (FWPCA)	EPA	All	Sections 301 and 304 direct EPA to develop effluent guidelines for point sources, including mineral ex-- traction activities
Effluent Guidelines and Standards for Mineral Mining and Processing	EPA	Sand and gravel (Section 436.30-436.32) Crushed Stone (Section 436.20-436.22) Salines (Section 436.120-436.122)	Establishes effluent standards as authorized by the FWPCA
Effluent Guidelines and Standards for Ore Mining and Dressing	EPA	Mercury (Section 440.60-440.62)	Establishes effluent standards as authorized by the FWPCA
Clean Air Amendments of 1970	EPA	Mercury	Section 112 directs EPA to establish emission standards for hazardous air pollutants and requires each State to develop a procedure for implementing and enforcing these standards.
STATE			
Health and Safety Code, Div. 26, Part 1, Chapter 6	Local air pollution control districts	Mercury	Section 40702 authorizes the Local Air Pollution Control Districts to enforce emission standards
Surface Mining and Reclamation Act of 1975	Local governments	Construction materials	Requires local governments to require mining operators to prepare reclamation plans prior to the issuing of an operating permit
Porter-Cologne Water Quality Control Act of 1969 (Water Code, Div. 7)	Regional Water Quality Control Boards	All	Authorizes the setting and enforcement of water discharge requirements for all mining operations
LOCAL			
Regulaitons of the Bay Area Air POllution Control District	BAAPCD	Mercury	Regulation 8 extablishes limits for the emission of mercury

WQ/Tech Memo 18/May 77

J. Naftzger

WATER QUALITY MANAGEMENT PLANS

ESTIMATED INDUSTRIAL WASTEWATER LOADS IN THE SAN FRANCISCO BAY REGION

TECHNICAL MEMORANDUM NO. 18
MAY 31, 1977

Summary

This memorandum presents estimated wastewater loads from significant discrete industrial sources in the San Francisco Bay Region for the years 1975-2000. For the years 1985-2000 two sets of estimates are given:

- Wastewater loads to conform to "best practicable treatment" standards (BPT), required by federal regulations to be implemented by 1977.

- Wastewater loads to conform to "best available treatment" standards (BAT), currently required to be implemented by 1983.

Because there is considerable discussion at present in Congress and elsewhere as to the desirability of modifying the stringency or time schedule of BAT requirements, the two sets of estimates given may be considered as upper and lower bounds for future discharges as governed by national effluent limitations.

The estimates given in this tech memo will be used as input to the Bay water quality models (mathematical), in conjunction with waste loadings from other sources, in order to study the probable effects on the Bay of estimated future pollutant discharge rates. The parameters covered, in addition to flow rate, are biochemical oxygen demand and total suspended solids; the nutrients, total nitrogen and total phosphorus; and ammonia, a component of total nitrogen.

Regional totals for the years 1975, 1985 and 2000 are summarized in Table 1.

TABLE 1

SUMMARY OF ESTIMATED INDUSTRIAL WASTE LOADINGS
AFTER TREATMENT FOR SAN FRANCISCO BAY REGION

Parameter	1975	1985	2000
Flows, million gallons/day:			
Average Industrial Flow[1,3]	72.6	71.6 49.2	79.2 55.4
Additions & Withdrawals[2]	-21.0	-21.0	-21.0
Net Flow	51.6	50.6 28.2	58.2 34.4
Pollutant Loadings, lbs/day			
Biochemical Oxygen Demand	119,245	24,595 9,385	25,140 9,705
Total Suspended Solids	52,590	36,915 17,950	38,895 19,300
Total Nitrogen	4,660	4,055 2,015	4,145 2,090
Total Phosphorus	325	370 215	395 235
Ammonia Nitrogen	3,425	3,640 1,650	3,690 1,690

NOTES:

[1] The total of waste flows to receiving water from sources other than receiving water. See notes a and b following Table 11.

[2] Several entities add non-polluted water or remove water from the Bay. This is significant to the Bay's hydraulics.

[3] For 1985 and 2000: Where two values are given for a single parameter, the first value is the total of estimates conforming to "best practicable treatment" requirements, the second relates to "best available treatment" requirements.

Conclusions

Several significant conclusions may be drawn from review of the data presented here and from a comparison with data for municipal sources given in WQ/Tech Memo 15:

- Discharge of pollutants by discrete industry is substantially less than that by municipal systems. In 1975 industry discharged 30% as much BOD as municipal plants, 20% as much suspended solids, 4% as much nitrogen and ammonia and less than 1% as much phosphorus. Under BPT requirements, the future percentages will be similar; under BAT requirements, the percentages will be substantially smaller.

- The industrial categories most significant in discharging pollutants are petroleum refineries, food processing plants, chemical plants and paper mills. All of these are required to reduce discharges significantly to meet BPT standards and will be required to cut back again to meet BAT. Some industries were closer to meeting BPT in 1975 than others.

- Discrete industrial discharges are concentrated in Contra Costa County. In any given year, 80% or more of total pollutant discharges from industry in the region are from locations in this county.

Methodology

a) Selection of "significant" dischargers

Nearly 200 industrial entities hold permits from Regional Water Quality Control Boards of the State of California to discharge water containing pollutants into San Francisco Bay or its tributaries. Only a small fraction of these have discharges which can be considered significant, however.

Regional Board files were reviewed carefully to obtain relevant information. In a first-cut screening, reported in WQ/Tech Memo 3, industries were included on the "significant" list which had a cooling-water-only flow of 0.2 mgd or more, or a flow including process water exceeding 0.1 mgd. These flow quantities are far smaller than would be significant hydraulically to the Bay system.

Further review was conducted to determine pollutant quantities for each plant on the list. Several entries on the original list were dropped when it was determined that the amount of pollutants discharged was not significant. The following criterion was adopted for inclusion of an industry on the final list:

- A significant discharge is one which releases a minimum of 30 pounds per day of any pollutant.

b) Projections of Discharge Quantities

The figures presented in this memo are estimates of pollutant discharges, on an annual average basis. These discharges are measured against the yardstick of the limits contained in the individual discharge permits. However, the longest averaging period for which the permits specify limits is 30 days. For many industries, the maximum of 30-day averages is roughly 1.5 times the annual average. Thus, for an industry to conform to its permit conditions, it would probably have an annual average discharge of pollutant X no higher than 2/3 of the permitted 30-day average.

The decision has been made, for all point-source discharge projections made for the ABAG Environmental Management Plan, to use permit limits on 30-day average discharge as if they were annual averages. This assumption is obviously conservative. The method of dealing with BPT requirements is as follows:

- Current discharge permits reflect EPA's BPT regulations. In general, future discharges conforming to BPT cannot exceed current permit limits.

- Where the current pollutant discharge rate exceeds 2/3 of the permit limit rate, the permit limit is taken as the annual average discharge rate, reflecting the assumption described above.

- Where the current annual average rate is less than 2/3 of the permit rate, the current rate has been multiplied by 1.5 to give an effective rate consistent with those in the sub-paragraph just above.

- These manipulations relate to projected values for 1980 and later years. 1975 data is presented "as is."

To work directly through production figures to make projections of future waste discharge quantities is difficult. Current production data for individual plants are very hard to acquire; actual rates of production increase for individual plants are difficult to predict; present and future pollutant generation rates as a function of production are also not easy to define. A generalized approach to growth has been adopted:

- Growth in production will occur at most plants. However, it is believed that this will occur substantially within existing excess production capacity.

- For many industries, the limits on pollutant discharge contained in the discharge permits are written based on available production capacity. This means that as production increases within present capacity, the current permit limits will remain in effect. This principle is believed to be applicable to most of the major pollutant dischargers.

- A general regional production growth rate was assumed, based on Series 3 projections of regional employment growth (Base Case 1), which showed an employment increase of around 40% by year 2000. This rate of increase was applied to flow rates and to pollutant discharge rates which are currently below permit limit values or for which permit limits have not been set.

- A lower growth rate has been assigned to a few industrial plants which are believed to be operating near capacity or to be otherwise limited.

No permits have been written using BAT treatment standards but EPA regulations have been written for most of the industrial categories of concern in the Bay Area. Projections conforming to BAT requirements have been made as follows:

- From EPA regulations, ratios have been established for BAT vs. BPT allowable discharges. Projected BAT permit limits for individual industries are then calculated from existing limits by application of these ratios. From this point, discharge projections conforming to BAT standards are made in the same manner as for BPT, described above.

- A few industries (e.g., shipyards) are not covered by EPA regulations. For these, the current level of control is assumed to remain in effect.

- It should be emphasized that the projected BAT permit limits are <u>not</u> recommended limits, but simply the best estimate by ABAG staff of what permit limits would be if EPA's BAT standards were applied to present production capacity.

Following are:

TABLE 2: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 1975

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig.1 for location)	Process[a] Flow(MGD)	Once-through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c] BOD5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co[f]	(-)6.2[g]	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.4[g]	20[e]	100[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5[g]	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon Co.	2.3	-	460	450	740[e]	-	740
Subtotal		(-)3.9		530	910	760	-	740
Contra Costa								
16 Antioch	203 Crown Zellerbach	3.5	7.8	7,520	1,100	75[e]	15[e]	-
	205 E.I. DuPont de Nemours & Co.	1.4	-	555	130	10[e]	10[e]	10[e]
	207 Fibreboard Corp.	13.7	-	29,900	8,300	300[e]	60[e]	-
	208 Hickmott Foods, Inc.	0.6	0.9	325	150	5[e]	5[e]	-
	212 P.G.&E.-Antioch	0.5	540	-	100[e]	-	-	-
	222 Tillie Lewis Foods, Inc.[h]	1.7	-	48,900	3,860	250[e]	50[e]	-
17 Pittsburg	201 Allied Chemical Corp.	2.0[n]	1.3[n]	140	-	10[e]	-	10[e]
	204 Dow Chemical, USA	0.5[n]	21.8[n]	370	5,200	-	-	-
	216 P.G.&E.-Pittsburg	0.3	904	-	9,000	-	-	-
	224 U.S. Steel Corp.	10.0[n]	12.0[n]	-	1,200	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5[n]	4.5[n]	600	945	410[e]	-	410
	213 P.G.&E.-Avon	0.3	-	-	200	-	-	-
	214 P.G.& E.-Martinez	0.2	-	-	-	-	-	-
	218 Shell Oil Co.	3.5	-	245	800	420[e]	-	420
19 Crockett-Port Costa	202 C&H Sugar Co.	1.7	17.8	18,500	640	90[e]	20[e]	-
20 Rodeo	215 P.G.&E.-Oleum	0.2	86	-	45	-	-	-
	223 Union Oil Co.	2.1	36.8	2,650	170	65[e]	-	65
21 Pinole	217 Pacific Refining	0.1	-	40	60	30[e]	-	30
	225 Valley Nitrogen[i]	1.8	-	-	480	620	-	235

TABLE 2 (continued)

23 Richmond	219 Chevron, USA	18.2[n]	91[n]	8,200	13,000	1,500[e]	-	1,500
	227 Willamette Iron & Steel Co., Shipyard	-	2.3[g]	65[e]	570[e]	20[e]	-	-
Subtotal		66.8		118,010	45,950	3,805	160	2,680
East Bay								
24 EBMUD	104 Colgate-Palmolive Co.	-	0.5	60	120	-	-	-
	105 DeLaval Turbine Co.	0.8	-	-	80	-	-	-
	109 Gerber Products Co.	0.4	-	90	20	-	-	-
	112 Merritt Ship Repair Co.	-	0.3[g]	5[e]	70[e]	-	-	-
	114 Todd Shipyard Co.	-	2.0[g]	35[e]	510[e]	15[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7[g]	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	600	-	-	-
	107 FMC Corp.	0.7	-	-	75	-	160	-
Subtotal		(-)0.8		190	1,475	15	160	-
Livermore Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1[g]	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World-Africa USA	-	1.4	35	35	30	5	5
43 So.SF, Airport, San Bruno	803 Merck & Co.	-	3.2	-	1,900[j]	-	-	-
	804 San Francisco Airport	1.4	-	350	880	-	-	-
Subtotal		1.4		385	2,815	30	5	5
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	2.4[g]	40[e]	595[e]	20[e]	-	-
	702 P.G.&E.-Hunters Point	0.2	258	-	-	-	-	-
	703 P.G.&E.-Potrero	-	347	-	-	-	-	-
	705 Triple A Shipyard	-	3.4[g]	90[e]	845[e]	30[e]	-	-
Subtotal		0.2		130	1,440	50	-	-
Regional Total Industry		51.6		119,245	52,590	4,660	325	3,425
Military Base								
	704 Treasure Isl. Naval Sta.	1.0[g]	-	250[e]	250[e]	250[e]	165[e]	210[e]

TABLE 3: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 1980 CONFORMING TO "BEST PRACTICABLE TREATMENT" (BPT, 1977) REQUIREMENTS

Subregion / Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-Through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c] BOD$_5$	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.4	20[e]	105[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon Co.	2.2	-	590[d]	490[d]	545[e]	-	545
Subtotal		(-)4.0		660	955	565	-	545
Contra Costa								
16 Antioch	203 Crown Zellerbach	3.8	8.4	3,060	4,220	50[e]	50[e]	-
	205 E.I. Dupont de Nemours &Co.	1.5	-	565	230[d]	10[e]	10[e]	10[e]
	207 Fibreboard Corp.	13.0	-	7,070	15,600	160[e]	160[e]	-
	208 Hickmott Foods, Inc.	0.6	1.0	165[d]	245[d]	10[e]	10[e]	-
	212 P.G.&E.-Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	1.6	1.1	215[e]	-	10[e]	-	10
	204 Dow Chemical, USA	0.5	4.0	75[d]	815	-	-	-
	216 P.G.&E.-Pittsburg	0.3	896	-	5,000[e]	-	-	-
	224 U.S. Steel Corp.	8.0	11.3	-	1,300[d]	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	975[d]	630[d]	680[e]	-	680
	213 P.G.&E.-Avon	0.3	-	-	55	-	-	-
	214 P.G.&E.-Martinez	0.2	-	-	50	-	-	-
	218 Shell Oil Co.	3.8	-	920[d]	1,310[d]	410[e]	-	410[d]
19 Crockett-Port Costa	202 C&H Sugar Co.	2.7	17.6	3,700	480[d]	20[e]	20[e]	-
20 Rodeo	215 P.G.&E.-Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.1	40	1,080	245[d]	110[e]	-	110[d]
21 Pinole	217 Pacific Refining	0.1	-	50[d]	80[d]	35[e]	-	35[d]
	225 Valley Nitrogen[i]	1.8	-	-	510	1,050[d]	-	400[d]

TABLE 3 (continued)

23 Richmond	219 Chevron, USA	19.5	97	4,800	3,200	1,800[e]	-	1,800
	227 Willamette Iron & Steel Co. Shipyard	-	2.4	70[e]	600[e]	20[e]	-	-
Subtotal		65.2		22,745	34,750	4,365	250	3,455
East Bay								
24 EBMUD	104 Colgate-Palmolive Co.	-	0.6	35	10	-	-	-
	105 DeLaval Turbine Co.	0.9	-	-	115[d]	-	-	-
	109 Gerber Products Co.	0.5	-	115[d]	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.3	5[e]	75[e]	-	-	-
	114 Todd Shipyard Co.	-	2.1	35[e]	535[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District [k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.	0.8	-	-	100	-	105	-
Subtotal		(-)0.5		190	1,315	20	105	-
Livermore-Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World-Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So. SF, Airport, San Bruno	803 Merck & Co.	-	3.6	-	2,140[e]	-	-	-
	804 San Francisco Airport	1.5	-	315	315	-	-	-
Subtotal		1.5		645	2,995	60	10	10
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	2.5	40[e]	625[e]	20[e]	-	-
	702 P.G.&E.-Hunters Point	0.2	280	-	30	-	-	-
	703 P.G.&E.-Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	3.7	95[e]	920[e]	35[e]	-	-
Subtotal		0.2		135	1,605	55	-	-
Regional Total, Industry		50.3		24,375	41,620	5,065	365	4,010
Military Base								
	704 Treasure Isl. Naval Sta.	1.0	-	250	250	250	165	210

TABLE 4: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 1985
CONFORMING TO "BEST PRACTICABLE TREATMENT" (BPT, 1977) REQUIREMENTS

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c]				
				BOD_5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.4	20[e]	115[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon	2.4	-	660[d]	550[d]	545[e]	-	545
Subtotal		(-)3.8		730	1,025	565	-	545
Contra Costa								
16 Antioch	203 Crown Zellerbach	4.1	9.1	3,060	4,220	50[e]	50[e]	-
	205 E.I. DuPont de Nemours & Co.	1.7	-	595	250[d]	10[e]	10[e]	10[e]
	207 Fibreboard Corp.	13.0	-	7,070	15,600	160[e]	160[e]	-
	208 Hickmott Foods, Inc.	0.7	1.1	175[d]	265[d]	10[e]	10[e]	-
	212 P.G.&E.-Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	1.7	1.2	230[e]	-	10[e]	-	10
	204 Dow Chemical, USA	0.6	4.3	80[d]	815	-	-	-
	216 P.G.&E.-Pittsburg	0.3	890	-	90	-	-	-
	224 U.S. Steel Corp.	7.0	11.5	-	1,390[d]	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	975[d]	630[d]	680[e]	-	680
	213 P.G.&E.-Avon	0.3	-	-	55	-	-	-
	214 P.G.&E.-Martinez	0.3	-	-	50	-	-	-
	218 Shell Oil Co.	4.0	-	965[d]	1,380	430[e]	-	430[d]
19 Crockett-Port Costa	202 C&H Sugar Co.	2.8	18.2	3,700	500[d]	25[e]	25[e]	-
20 Rodeo	215 P.G.&E.-Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.3	42	1,080	275[d]	120[e]	-	120[d]
21 Pinole	217 Pacific Refining	0.2	-	55[d]	90[d]	35[e]	-	35[d]

TABLE 4 (Continued)

23 Richmond	219 Chevron, USA	20.7	103	4,800	3,200	1,800[e]	-	1,800
	227 Willamette Iron & Steel Co., Shipyard	-	2.6	70[e]	635[e]	25[e]	-	-
Subtotal		65.1		22,855	29,625	3,355	255	3,085
East Bay								
24 EBMUD	104 Colgate-Palmolive Co.	-	0.6	35	10	-	-	-
	105 DeLaval Turbine Co.	1.0	-	-	130[d]	-	-	-
	109 Gerber Products Co.	0.5	-	125[d]	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.3	5[e]	75[e]	-	-	-
	114 Todd Shipyard Co.	-	2.2	35[e]	560[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.	0.8	-	-	100	-	105	-
Subtotal		(-)0.4		200	1,355	20	105	-
Livermore Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World-Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So.SF, Airport, San Bruno	803 Merck & Co.	-	3.9	-	2,320[e]	-	-	-
	804 San Francisco Airport	1.6	-	335	335	-	-	-
Subtotal		1.6		665	3,195	60	10	10
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	2.6	45[e]	655[e]	20[e]	-	-
	702 P.G.&E.-Hunters Point	0.2	280	-	30	-	-	-
	703 P.G.&E.-Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	4.0	100[e]	1,000[e]	35[e]	-	-
Subtotal		0.2		145	1,715	55	-	-
Regional Total, Industry		50.6		24,595	36,915	4,055	370	3,640
Military Base	704 Treasure Isl. Naval Sta.	1.0	-	250	250	250	165	210

TABLE 5: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 1990 CONFORMING TO "BEST PRACTICABLE TREATMENT" (BPT, 1977) REQUIREMENTS

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c] BOD_5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.5	20[e]	120[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon	2.7	-	730[d]	610[d]	545[e]	-	545
Subtotal		(-)3.5		800	1,090	565	-	545
Contra Costa								
16 Antioch	203 Crown Zellerbach	4.4	9.7	3,060	4,220	55[e]	55[e]	-
	205 E.I. DuPont de Nemours & Co.	1.8	-	645	275	15[e]	15[e]	15[e]
	207 Fibreboard Corp.	13.0	-	7,070	15,600	160[e]	160[e]	-
	208 Hickmott Foods, Inc.	0.7	1.2	190[d]	285[d]	10[e]	10[e]	-
	212 PG&E - Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	1.9	1.2	250[e]	-	10[e]	-	10
	204 Dow Chemical, USA	0.6	4.6	85d	815	-	-	-
	216 PG&E - Pittsburg	0.3	890	-	90	-	-	-
	224 U.S. Steel Corp.	6.3	11.7	-	1,490[d]	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	975[d]	630[d]	680[e]	-	680
	213 PG&E - Avon	0.3	-	-	55	-	-	-
	214 PG&E - Martinez	0.3	-	-	50	-	-	-
	218 Shell Oil Co.	4.0	-	965[d]	1,380	430[e]	-	430[d]
19 Crockett-Port Costa	202 C&H Sugar Co.	3.0	18.8	3,700	530[d]	25[e]	25[e]	-
20 Rodeo	215 PG&E - Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.6	45	1,080	305[d]	135[e]	-	135[d]
21 Pinole	217 Pacific Refining	0.2	-	60[d]	100[d]	40[e]	-	40[d]
23 Richmond	219 Chevron, USA	21.9	110	4,800	3,200	1,800[e]	-	1,800
	227 Willamette Iron & Steel Co. Shipyard	-	2.7	75[e]	670[e]	25[e]	-	-
Subtotal		66.7		22,955	29,875	3,385	265	3,110

TABLE 5 (Continued)

East Bay								
24 EBMUD	104 Colgate-Palmolive Co.	-	0.7	40	15	-	-	-
	105 DeLaval Turbine Co.	1.1	-	-	140[d]	-	-	-
	109 Gerber Products Co.	0.6	-	140[d]	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.3	5[e]	80[e]	-	-	-
	114 Todd Shipyard Co.	-	2.4	40[e]	585[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.	0.9	-	-	100	-	105	-
Subtotal		(-)0.1		225	1,400	20	105	-
Livermore Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-12.1)	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World - Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So. SF, Airport, San Bruno	803 Merck & Co.	-	4.3	-	2,550[e]	-	-	-
	804 San Francisco Airport	1.7	-	355	355	-	-	-
Subtotal		1.7		685	3,445	60	10	10
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	2.7	45[e]	685[e]	25[e]	-	-
	702 PG&E - Hunters Point	0.2	280	-	30	-	-	-
	703 PG&E - Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	4.3	105[e]	1,075[e]	40[e]	-	-
Subtotal		0.2		150	1,820	65	-	-
Regional Total, Industry		52.9		24,815	37,630	4,095	380	3,665
Military Base	704 Treasure Island Naval Station	1.0	-	250	250	250	165	210

TABLE 6: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 1995 CONFORMING TO "BEST PRACTICABLE TREATMENT" (BPT, 1977) REQUIREMENTS

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-Through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c]				
				BOD_5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.5	20[e]	125[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon Co.	2.9	-	775[d]	650	545[e]	-	545
Subtotal		(-)3.3		845	1,135	565	-	545
Contra Costa								
16 Antioch	203 Crown Zellerbach	4.7	10.4	3,060	4,220	60[e]	60[e]	-
	205 E.I. Dupont de Nemours &Co.	2.0	-	695	295	15[e]	15[e]	15[e]
	207 Fibreboard Corp.	13.0	-	7,070	15,600	160[e]	160[e]	-
	208 Hickmott Foods, Inc.	0.8	1.2	200[d]	305[d]	10[e]	10[e]	-
	212 P.G.&E.-Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	2.0	1.3	265[e]	-	10[e]	-	10
	204 Dow Chemical, USA	0.7	4.9	90[d]	815	-	-	-
	216 P.G.&E.-Pittsburg	0.3	890	-	90	-	-	-
	224 U.S. Steel Corp.	6.3	11.7	-	1,580[d]	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	975[d]	630[d]	680[e]	-	680
	213 P.G.&E.-Avon	0.3	-	-	55	-	-	-
	214 P.G.&E.-Martinez	0.3	-	-	50	-	-	-
	218 Shell Oil Co.	4.0	-	965[d]	1,380	430[e]	-	430[d]
19 Crockett-Port Costa	202 C&H Sugar Co.	3.1	19.4	3,700	560[d]	25[e]	25[e]	-
20 Rodeo	215 P.G.&E.-Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.8	47	1,080	335[d]	150[e]	-	150[d]
21 Pinole	217 Pacific Refining	0.2	-	65[d]	110[d]	45[e]	-	45[d]

TABLE 6 (Continued)

23 Richmond	219 Chevron, USA	23.1	115	4,800	3,200	1,800[e]	-	1,800
	227 Willamette Iron & Steel Co. Shipyard	-	2.8	75[e]	700[e]	25[e]	-	-
Subtotal		69.0		23,040	30,105	3,410	270	3,130
East Bay								
24 EBMUD	104 Colgate-Palmolive Co.	-	0.7	40	15	-	-	-
	105 DeLaval Turbine Co.	1.2	-	-	155[d]	-	-	-
	109 Gerber Products Co.	0.6	-	150[d]	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.3	5[e]	85[e]	-	-	-
	114 Todd Shipyard Co.	-	2.5	40[e]	610[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.	1.0	-	-	100	-	105	-
Subtotal		0.1		235	1,445	20	105	-
Livermore Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World-Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So. SF, Airport, San Bruno	803 Merck & Co.	-	4.7	-	2,790[e]	-	-	-
	804 San Francisco Airport	1.8	-	375	375	-	-	-
Subtotal		1.8		705	3,705	60	10	10
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	2.9	50[e]	715[e]	25[e]	-	-
	702 P.G.&E.-Hunters Point	0.2	280	-	30	-	-	-
	703 P.G.&E.-Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	4.6	110[e]	1,150[e]	40[e]	-	-
Subtotal		0.2		160	1,925	65	-	-
Regional Total, Industry		55.7		24,985	38,315	4,120	385	3,685
Military Base								
	704 Treasure Isl. Naval Sta.	1.0	-	250	250	250	165	210

TABLE 7: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 2000
CONFORMING TO "BEST PRACTICABLE TREATMENT" (BPT, 1977) REQUIREMENTS

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-Through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c]				
				BOD_5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co.Shipyard	-	0.5	25[e]	135[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon Co.	2.9	-	775[d]	650	545[e]	-	545
Subtotal		(-)3.3		850	1,145	565	-	545
Contra Costa								
16 Antioch	203 Crown Zellerbach	5.0	11.0	3,060	4,220	65[e]	65[e]	-
	205 E.I. Dupont de Nemours &Co.	2.1	-	740	315	15[e]	15[e]	15[e]
	207 Fibreboard Corp	13.0	-	7,070	15,600	160[e]	160[e]	-
	208 Hickmott Foods, Inc.	0.8	1.3	215[d]	320[d]	10[e]	10[e]	-
	212 P.G.&E.-Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	2.1	1.4	280[e]	-	10[e]	-	10
	204 Dow Chemical, USA	0.7	5.2	100[d]	815	-	-	-
	216 P.G.&E.-Pittsburg	0.3	890	-	90	-	-	-
	224 U.S. Steel Corp.	6.3	11.7	-	1,680[d]	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	975[d]	630[d]	680[e]	-	680
	213 P.G.&E.-Avon	0.3	-	-	55	-	-	-
	218 Shell Oil Co.	4.0	-	965[d]	1,380	430[e]	-	430[d]
	214 P.G.&E.-Martinez	0.3	-	-	50	-	-	-
19 Crockett-Port Costa	202 C&H Sugar Co.	3.3	20	3,700	590[d]	30[e]	30[e]	-
20 Rodeo	215 P.G.&E.-Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.9	48	1,080	340[d]	150[e]	-	150[d]
21 Pinole	217 Pacific Refining	0.2	-	75[d]	120[d]	50[e]	-	50[d]

TABLE 7 (Continued)

23 Richmond	219 Chevron, USA	24.4	122	4,800	3,200	1,800[e]	-	1,800
	227 Willamette Iron & Steel	-	3.0	80[e]	735[e]	25[e]	-	-
Subtotal		71.1		23,140	30,320	3,425	280	3,135
East Bay								
24 EBMUD	104 Colgate-PalmoliveCo.	-	0.8	45	15	-	-	-
	105 DeLaval Turbine Co.	1.3	-	-	165[d]	-	-	-
	109 Gerber Products Co.	0.7	-	165[d]	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.4	5[e]	90[e]	5[e]	-	-
	114 Todd Shipyard Co.	-	2.6	45[e]	640[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.	1.1	-	-	100	-	105	-
Subtotal		0.4		260	1,490	25	105	-
Livermore Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World-Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So. SF, Airport, San Bruno	803 Merck & Co.	-	5.0	-	2,970[e]	-	-	-
	804 San Francisco Airport	1.9	-	395	395	-	-	-
Subtotal		1.9		725	3,905	60	10	10
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	3.0	50[e]	745[e]	25[e]	-	-
	702 P.G.&E.-Hunters Point	0.2	280	-	30	-	-	-
	703 P.G.&E.-Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	4.9	115[e]	1,230[e]	45[e]	-	-
Subtotal		0.2		165	2,035	70	-	-
Regional Total, Industry		58.2		25,140	38,895	4,145	395	3,690
Military Base	704 Treasure Isl. Naval Sta.	1.0	-	250	250	250	165	210

TABLE 8: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 1985
CONFORMING TO "BEST AVAILABLE TREATMENT" (BAT, 1983) REQUIREMENTS

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-Through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c] BOD_5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.4	20[e]	115[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon Co.	1.2	-	175	140	225[e]	-	225
Subtotal		(-)5.0		245	615	245	-	225
Contra Costa								
16 Antioch	203 Crown Zellerbach	3.3	9.1	1,325	1,350	40[e]	40[e]	-
	205 E.I. Dupont de Nemours & Co.	1.3	-	300	250[d]	10[e]	10[e]	10[e]
	207 Fibreboard Corp.	10.4	-	3,060	5,460	130[e]	130[e]	-
	208 Hickmott Foods, Inc.	0.5	1.1	175[d]	240	5[e]	5[e]	-
	212 P.G.&E.-Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	1.4	1.2	230[e]	-	-	-	-
	204 Dow Chemical, USA	0.6	4.3	80[d]	410	-	-	-
	216 P.G.&E.-Pittsburg	0.3	890	-	90	-	-	-
	224 U.S. Steel Corp.	3.5	8.6	-	300	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	215	215	280[e]	-	280
	213 P.G.&E.-Avon	0.3	-	-	55	-	-	-
	214 P.G.&E.-Martinez	0.3	-	-	50	-	-	-
	218 Shell Oil Co.	3.8	-	425	430	255[e]	-	255
19 Crockett-Port Costa	202 C&H Sugar Co.	2.3	18	775	300	20[e]	20[e]	-
20 Rodeo	215 P.G.&E.-Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.3	42	265	215	120[e]	-	120[d]
21 Pinole	217 Pacific Refining	0.2	-	30	30	35[e]	-	35[d]

TABLE 8 (Continued)

23 Richmond	219 Chevron, USA	8.8	103	1,180	960	715[e]	-	715
	227 Willamette Iron & Steel Shipyard	-	2.6	70[e]	635[e]	25[e]	-	-
Subtotal		44.7		8,130	11,170	1,635	205	1,415
East Bay								
24 EBMUD	104 Colgate-Palmolive Co.	-	0.6	35	10	-	-	-
	105 DeLaval Turbine Co.	1.0	-	-	130[d]	-	-	-
	109 Gerber Products Co.	0.5	-	125[d]	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.3	5[e]	75[e]	-	-	-
	114 Todd Shipyard Co.	-	2.2	35[e]	560[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.[m]	-	-	-	-	-	-	-
Subtotal		(-)1.2		200	1,255	20	-	-
Livermore Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World-Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So. SF, Airport, San Bruno	803 Merck & Co.	-	3.9	-	2,320[e]	-	-	-
	804 San Francisco Airport	1.6	-	335	335	-	-	-
Subtotal		1.6		665	3,195	60	10	10
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	2.6	45[e]	655[e]	20[e]	-	-
	702 P.G.&E-Hunters Point	0.2	280	-	30	-	-	-
	703 P.G.&E.-Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	4.0	100[e]	1,000[e]	35[e]	-	-
Subtotal		0.2		145	1,715	55	-	-
Regional Total, Industry		28.2		9,385	17,950	2,015	215	1,650
Military Base	704 Treasure Isl. Naval Sta.	1.0	-	250	250	250	165	210

TABLE 9: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 1990 CONFORMING TO "BEST AVAILABLE TREATMENT" (BAT,1983) REQUIREMENTS

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-Through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c] BOD_5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.5	20[e]	120[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon Co.	1.3	-	175	140	225[e]	-	225
Subtotal		(-)4.9		245	620	245	-	225
Contra Costa								
16 Antioch	203 Crown Zellerbach	3.5	9.7	1,325	1,350	45[e]	45[e]	-
	205 E.I. Dupont de Nemours & Co.	1.5	-	325	275[d]	15[e]	15[e]	15[e]
	207 Fibreboard Corp.	10.4	-	3,060	5,460	130[e]	130[e]	-
	208 Hickmott Foods, Inc.	0.6	1.2	190[d]	240	5[e]	5[e]	-
	212 P.G.&E.-Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	1.5	1.2	250[e]	-	-	-	-
	204 Dow Chemical, USA	0.6	4.6	85[d]	410	-	-	-
	216 P.G.&E.-Pittsburg	0.3	890	-	90	-	-	-
	224 U.S. Steel Corp.	3.2	8.8	-	300	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	215	215	280[e]	-	280
	213 P.G.&E-Avon	0.3	-	-	55	-	-	-
	214 P.G.&E.-Martinez	0.3	-	-	50	-	-	-
	218 Shell Oil Co.	3.8	-	425	430	255[e]	-	255
19 Crockett-Port Costa	202 C&H Sugar Co.	2.4	19	775	300	20[e]	20[e]	-
20 Rodeo	215 P.G.&E.-Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.6	45	265	215	135[e]	-	135[d]
21 Pinole	217 Pacific Refining	0.2	-	30	30	40[e]	-	40

TABLE 9 (Continued)

23 Richmond	219 Chevron, USA	9.8	110	1,180	960	715[e]	-	715
	227 Willamette Iron & Steel Shipyard	-	2.7	75[e]	670[e]	25[e]	-	-
Subtotal		46.4	-	8,200	11,230	1,665	215	1,440
East Bay 24 EBMUD	104 Colgate-Palmolive Co.	-	0.7	40	15	-	-	-
	105 DeLaval Turbine Co.	1.1	-	-	140[d]	-	-	-
	109 Gerber Products Co.	0.6	-	140[d]	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.3	5[e]	80[e]	-	-	-
	114 Todd Shipyard Co.	-	2.4	40[e]	585[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.[m]	-	-	-	-	-	-	-
Subtotal		(-)1.0		225	1,300	20	-	-
Livermore Valley	No significant discharges							
South Bay 34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1	-	-	-	-	-	-
San Mateo 37 Redwood City	802 Marine World-Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So. SF, Airport, San Bruno	803 Merck & Co.	-	4.3	-	2,550[e]	-	-	-
	804 San Francisco Airport	1.7	-	355	355	-	-	-
Subtotal		1.7		685	3,445	60	10	10
San Francisco 48 Southeast	701 Bethlehem Steel Shipyard	-	2.7	45[e]	685[e]	25[e]	-	-
	702 P.G.&E-Hunters Point	0.2	280	-	30	-	-	-
	703 P.G.&E.-Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	4.3	105[e]	1,075[e]	40[e]	-	-
Subtotal		0.2		150	1,820	65	-	-
Regional Total, Industry		30.3		9,505	18,415	2,055	225	1,675
Military Base	704 Treasure Isl. Naval Sta.	1.0	-	250	250	250	165	210

TABLE 10: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 1995 CONFORMING TO "BEST AVAILABLE TREATMENT" (BAT, 1983) REQUIREMENTS

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-Through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c]				
				BOD_5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.5	20[e]	125[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon Co.	1.4	-	175	140	225[e]	-	225
Subtotal		(-)4.8		245	625	245	-	225
Contra Costa								
16 Antioch	203 Crown Zellerbach	3.8	10.4	1,325	1,350	45[e]	45[e]	-
	205 E.I. Dupont de Nemours&Co.	1.6	-	350	295[d]	15[e]	15[e]	15[e]
	207 Fibreboard Corp.	10.4	-	3,060	5,460	130[e]	130[e]	-
	208 Hickmott Foods, Inc.	0.6	1.2	200[d]	240	10[e]	10[e]	-
	212 PG&E-Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	1.6	1.3	265[e]	-	-	-	-
	204 Dow Chemical, USA	0.7	4.9	90[d]	410	-	-	-
	216 PG&E-Pittsburg	0.3	890	-	90	-	-	-
	224 U.S. Steel Corp.	3.2	8.8	-	300	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	215	215	280[e]	-	280
	213 PG&E-Avon	0.3	-	-	55	-	-	-
	214 PG&E-Martinez	0.3	-	-	50	-	-	-
	218 Shell Oil Co.	3.8	-	425	430	255[e]	-	255
19 Crockett-Port Costa	202 C&H Sugar Co.	2.5	19	775	300	20[e]	20[e]	-
20 Rodeo	215 PG&E-Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.8	47	265	215	150[e]	-	150[d]
21 Pinole	217 Pacific Refining	0.2	-	30	30	40[e]	-	40

TABLE 10(Continued)

23 Richmond	219 Chevron, USA	10.7	115	1,180	960	715[e]	-	715
	227 Willamette Iron & Steel Shipyard	-	2.8	75[e]	700[e]	25[e]	-	-
Subtotal		48.2		8,255	11,280	1,685	220	1,455
East Bay								
24 EBMUD	104 Colgate-Palmolive Co.	-	0.7	40	15	-	-	-
	105 DeLaval Turbine Co.	1.2	-	-	155[d]	-	-	-
	109 Gerber Products Co.	0.6	-	150	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.3	5[e]	85[e]	-	-	-
	114 Todd Shipyard Co.	-	2.5	40[e]	610[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.[m]	-	-	-	-	-	-	-
Subtotal		(-)0.9		235	1,345	20	-	-
Livermore Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World-Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So. SF, Airport, San Bruno	803 Merck & Co.	-	4.7	-	2,790[e]	-	-	-
	804 San Francisco Airport	1.8	-	375	375	-	-	-
Subtotal		1.8		705	3,705	60	10	10
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	2.9	50[e]	715[e]	25[e]	-	-
	702 P.G.&E-Hunters Point	0.2	280	-	30	-	-	-
	703 P.G.&E.-Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	4.6	110[e]	1,150[e]	40[e]	-	-
Subtotal		0.2		160	1,925	65	-	-
Regional Total, Industry		32.4		9,600	18,800	2,075	230	1,690
Military Base	704 Treasure Isl. Naval Sta.	1.0	-	250	250	250	165	210

TABLE 11: ESTIMATED DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT IN 2000 CONFORMING TO "BEST AVAILABLE TREATMENT" (BAT, 1983) REQUIREMENTS

Subregion Sewerage unit number and name	Discharger No. & Name (see Fig. 1 for location)	Process[a] Flow(MGD)	Once-Through[b] Flow(MGD)	Pollutant Discharges (lbs/day)[c] BOD_5	TSS	TN	TP	NH_3-N
Marin-Sonoma	No significant discharges							
Napa-Solano								
11 Napa-American Canyon	111 Leslie Salt Co.[f]	(-)6.2	-	-	-	-	-	-
	401 Kaiser Steel Co. Shipyard	-	0.5	25[e]	135[e]	5[e]	-	-
12 Vallejo-Mare Island	302 Mare Island Naval Shipyard	-	1.5	50[e]	360[e]	15[e]	-	-
13 Benicia	301 Exxon Co.	1.4	-	175	140	225[e]	-	225
Subtotal		(-)4.8		250	635	245	-	225
Contra Costa								
16 Antioch	203 Crown Zellerbach	4.0	11.0	1,325	1,350	50[e]	50[e]	-
	205 E.I. Dupont de Nemours & Co.	1.7	-	370	315[d]	15[e]	15[e]	15[e]
	207 Fibreboard Corp.	10.4	-	3,060	5,460	130[e]	130[e]	-
	208 Hickmott Foods, Inc.	0.7	1.3	215[d]	240	10[e]	10[e]	-
	212 P.G.&E.-Antioch	0.7	600	-	100	-	-	-
17 Pittsburg	201 Allied Chemical Corp.	1.7	1.4	280[e]	-	-	-	-
	204 Dow Chemical, USA	0.7	5.2	100[d]	410	-	-	-
	216 P.G.&E.-Pittsburg	0.3	890	-	90	-	-	-
	224 U.S. Steel Corp.	3.2	8.8	-	300	-	-	-
18 Central Contra Costa	210 Lion Oil Co.	4.5	4.5	215	215	280[e]	-	280
	213 P.G.&E.-Avon	0.3	-	-	55	-	-	-
	214 P.G.&E.-Martinez	0.3	-	-	50	-	-	-
	218 Shell Oil Co.	3.8	-	425	430	255[e]	-	255
19 Crockett-Port Costa	202 C&H Sugar Co.	2.6	20	775	300	20[e]	20[e]	-
20 Rodeo	215 P.G.&E.-Oleum	0.2	80	-	80	-	-	-
	223 Union Oil Co.	2.9	48	265	215	150[e]	-	150[d]
21 Pinole	217 Pacific Refining	0.2	-	30	30	40[e]	-	40

TABLE 11 (Continued)

23 Richmond	219 Chevron, USA	11.7	122	1,180	960	715[e]	-	715
	227 Willamette Iron & Steel Shipyard	-	3.0	80[e]	735[e]	25[e]	-	-
Subtotal		49.9		8,320	11,335	1,690	225	1,455
East Bay								
24 EBMUD	104 Colgate-Palmolive Co.	-	0.8	45	15	-	-	-
	105 DeLaval Turbine Co.	1.3	-	-	165[d]	-	-	-
	109 Gerber Products Co.	0.7	-	150	30	-	-	-
	112 Merritt Ship Repair Co.	-	0.4	5[e]	90[e]	5[e]	-	-
	114 Todd Shipyard Co.	-	2.6	45[e]	640[e]	20[e]	-	-
28 Alvarado	111 Leslie Salt Co.[f]	(-)9.7	-	-	-	-	-	-
29 Newark	101 Alameda Co. Water District[k]	7.0	-	-	450[e]	-	-	-
	107 FMC Corp.[m]	-	-	-	-	-	-	-
Subtotal		(-)0.7		245	1,390	25	-	-
Livermore Valley	No significant discharges							
South Bay								
34 Sunnyvale	111 Leslie Salt Co.[f]	(-)12.1	-	-	-	-	-	-
San Mateo								
37 Redwood City	802 Marine World-Africa USA	-	13	330	540	60[e]	10[e]	10[e]
43 So. SF, Airport, San Bruno	803 Merck & Co.	-	5.0	-	2,970	-	-	-
	804 San Francisco Airport	1.9	-	395	395	-	-	-
Subtotal		1.9		725	3,905	60	10	10
San Francisco								
48 Southeast	701 Bethlehem Steel Shipyard	-	3.0	50[e]	745[e]	25[e]	-	-
	702 P.G.&E.-Hunters Point	0.2	280	-	30	-	-	-
	703 P.G.&E.-Potrero	-	350	-	30	-	-	-
	705 Triple A Shipyard	-	4.9	115[e]	1,230[e]	45[e]	-	-
Subtotal		0.2		165	2,035	70	-	-
Regional Total, Industry		34.4		9,705	19,300	2,090	235	1,690
Military Base								
	704 Treasure Isl. Naval Sta.	1.0	-	250	250	250	165	210

FOOTNOTES TO TABLES 2-11

[a] "Process Flow" = waste flow in million gallons/day, added to receiving water; source is other than receiving water.

[b] "Once-Through Flow" = water withdrawn from receiving water and returned thence after use; mainly cooling water.

[c] Pollutant discharge rates given are annual average rates. For 1975, except as noted, the figures have been obtained from self-monitoring report data on file at the Regional Water Quality Control Boards (Table #2). For 1980 and beyond, BPT requirements (Tables 3-7), the values are equal to current NPDES permit maximum limits for 30-day average discharge rates, except where noted otherwise. For 1985 and beyond, BAT requirements (Tables 8-11), the figures are estimated as conforming to BAT standards. See text for amplification.

BOD_5 = 5-day biochemical oxygen demand at 20°C.
TSS = total suspended solids
TN = total combined nitrogen
TP = total combined phosphorus
NH_3 = ammonia nitrogen

[d] Estimated discharge rate based on current rate, which is less than permit limit. See text.

[e] No permit limit, parameter not monitored. Discharge rate estimated by ABAG staff.

[f] Leslie Salt Co. withdraws water from the bay system in several locations for production of salt. Flow rates given are annual averages. Dry weather 6-month rates are approximately twice those given. Withdrawals in the South Bay occur in Sewerage Units 27 through 30 and 33 through 37, but are shown as concentrated in SU 28 and 34, for modeling convenience.

[g] Flow rate estimated.

[h] Closed down as of October 1976.

[i] Will join subregional system after 1980.

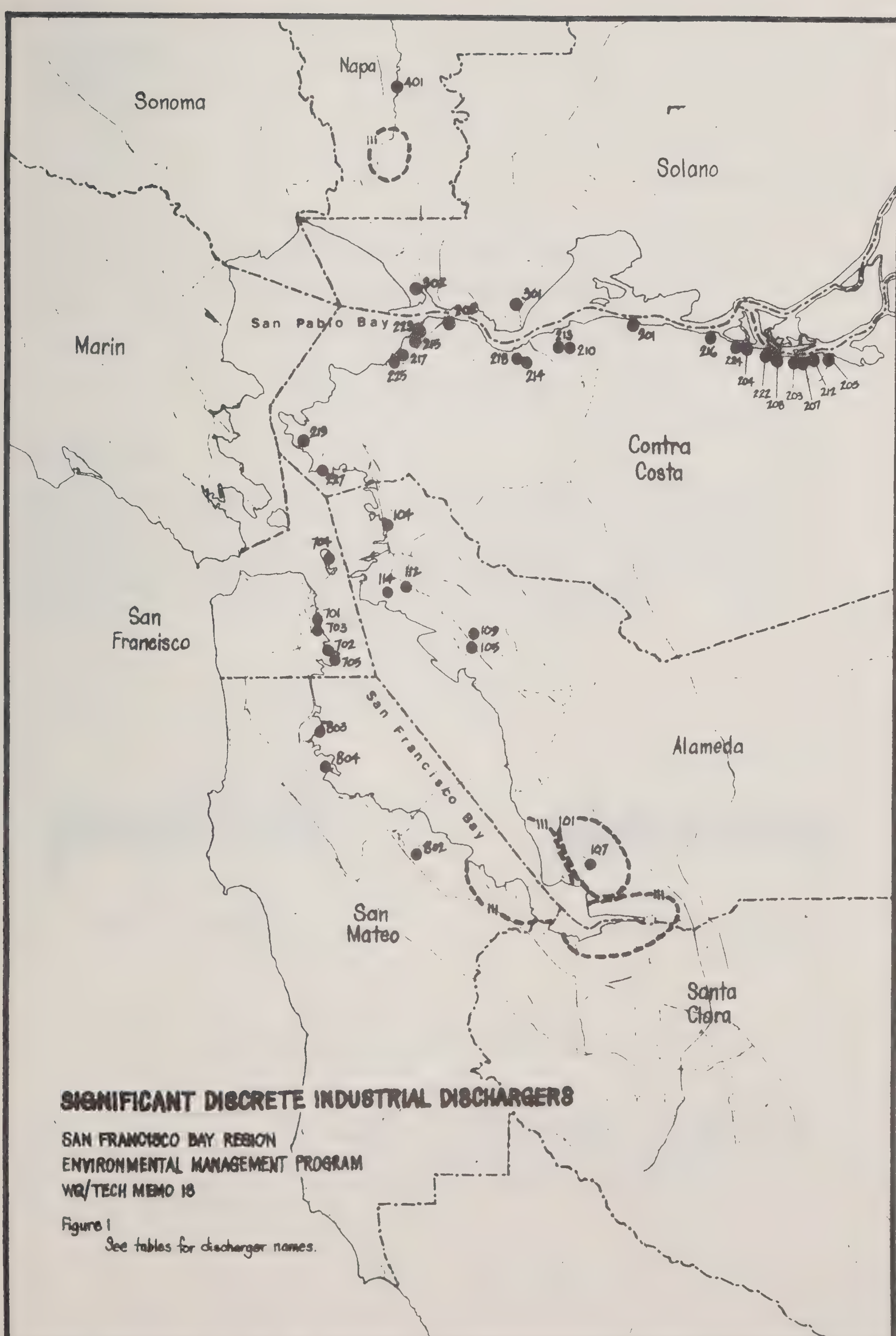
[j] The Merck and Co. process precipitates MgOH from sea water at elevated pH. The average measured discharge of suspended solids in 1975 was 19,000 lbs/day. It is assumed that most of the suspended solids in the effluent redissolve on being dispersed in the bay.

[k] Alameda County Water District pumps brackish ground water in its program of rehabilitation of the Niles Cone ground water basin. This water is discharged into the bay.

[l]

[m] Zero discharge will probably be required under BAT.

[n] Division between process and once-through flow is estimated.



SIGNIFICANT DISCRETE INDUSTRIAL DISCHARGERS

SAN FRANCISCO BAY REGION
ENVIRONMENTAL MANAGEMENT PROGRAM
WQ/TECH MEMO 18

Figure 1
See tables for discharger names.

WQ/Tech Memo 20
T. Bursztynsky
J. Perkins

June, 1977

Water Quality Management Plans

Salt Intrusion into Groundwaters

Technical Memorandum No. 20

Revised December 21, 1977

INTRODUCTION

Demand for groundwater as a source of water supply in excess of natural fresh water recharge results in a lowering of the groundwater table. When the water table is lowered to the point where the hydraulic gradient slopes downward toward the land, salt water from the ocean or brackish water from the Bay can mix with the groundwater in an area. This process is termed salt water intrusion (Figure 1).

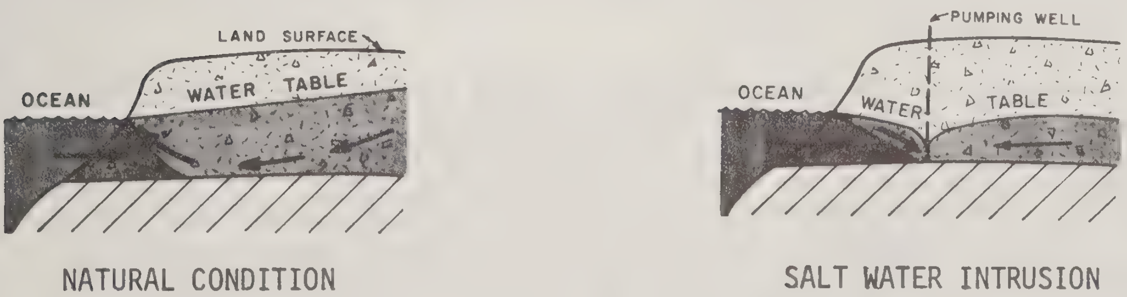


Figure 1: SALT WATER INTRUSION

Drought conditions in 1975-76 have increased the demand on public water supplies that rely on groundwater and many individuals have had wells drilled or reopened existing wells to augment the diminishing public surface water supplies. At the same tim, less rain has fallen to recharge the groundwater.

Although salt water intrusion is directly related to overdraft, it can be aggravated when paving and other products of urban development create large amounts of impervious surface, thereby reducing the amount of fresh water that can percolate to the groundwater. Also, dredging can breach the clay layer that may be separating the heavier salt water from the underlying lighter groundwater. Careless well abandonment can create a means for salt or polluted water to gain access to the underlying fresh groundwater.

Another source of salt intrusion is the percolation of septic tank drainage into this soil or the deliberate disposal of treated wastewater to the ground. These sources contribute salts to the groundwater, even when they are properly performing the intended function of wastewater disposal. When these disposal methods are functioning improperly, then wastewaters may pond on the surface, drain to a neaby water course or may add bacteria, viruses and other pollutants to the groundwater. Improper functioning of these methods is addressed in Technical Memorandum No. 4, Septic Tank Systems - The Problem and Possible Solutions. The unique situation of wastewater salt migration to the groundwater is addressed as a salt intrusion problem.

WATER QUALITY PROBLEMS ASSOCIATED WITH SALT INTRUSION

Salt contamination is commonly documented through the measurement of higher chloride concentrations but other dissolved ions may cause problems. Contamination is commonly defined as occurring when the concentration of Chloride exceeds 100 parts per million (Santa Clara Valley Water District, 1973; California Department of Water Resources, 1975). However, the maximum chloride concentration advised by the U.S. Public Health Services guidelines of 1962 for public water supplies is 25 ppm, less than 25 ppm is preferred. This limit is for taste purposes, not because it is a health hazard.

It is the opinion of physicians that persons with heart disease, renal disease, high blood pressure and those on low sodium diets could suffer ill effects from too much salt in the drinking water. The ratio of sodium to chloride in sea water is approximatley 1:1.5. At 250 mg/l of chloride, the corresponding sodium level is 167 mg/l. The Contra Costa County Health Department advises that when drinking water supplies exceed 25 mg/l of chloride (167 mg/l of sodium) persons with the previously mentioned problem should consider bottled water or consult with their physicians.

Another common dissolved ion that has caused illness is nitrate. Although nitrate may occur naturally in groundwater, as can chloride, it is usually indicative of high nitrate surface waters percolating to the groundwater. Nitrates are found in secondary level treated wastewaters, septic tank discharges and agricultural drain-water. Nitrate concentrations in excess of 45 mg/l expressed as nitrate, or 10 mg/l as nitrogen, have been documented to cause blood disorders in infants and children.

TABLE 1. AREAS RELYING ON GROUNDWATER FOR WATER SUPPLY[a]

Alameda County

Alameda Co. Water District[b]
CA Water Service Co.[b]
Valley Community Ser. Dist.[b]

Contra Costa County

City of Brentwood

Marin County

Coast Springs Water Co.
Stinson Beach Water Co.[b]

Napa County

City of Calistoga[b]

San Mateo County

City of South San Francisco[b]
Citizens Utility Co.[b]
Coastside Co. Water Dist.[b]
City of Daly City
O'Connor Tract Coop. Water Dist.
Palo Alto Park Mutual Water Co.
City of San Bruno[b]

Santa Clara County

Cal. Water Service Co.[b]
Campbell Water Co.
City of Cupertino[b]
City of Gilroy
City of Mt. View[b]
No. Los Altos Water Co.
Redwood Mutual Water Co.[b]
City of San Jose[b]
San Jose Highlands Water Co.
San Jose Waterworks[b]
City of Santa Clara[b]
Stanford University[b]
City of Sunnyvale[b]
Santa Clara Valley Water District[bc]

Solano County

City of Rio Vista
City of Suisun City[b]
City of Vacaville[b]

Sonoma County

City of Cloverdale
City of Healdsburg
City of Petaluma[b]
City of Sebastopol
Valley of the Moon[b] Co. Water Dist.
Great Oaks Water Co., Inc.
Magic Sands Mobile Home
City of Morgan Hill

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[a]Limerinos and Van Dine, 1971

[b]Rely only partially on groundwater

[c]Supplies water to many of previously listed agencies

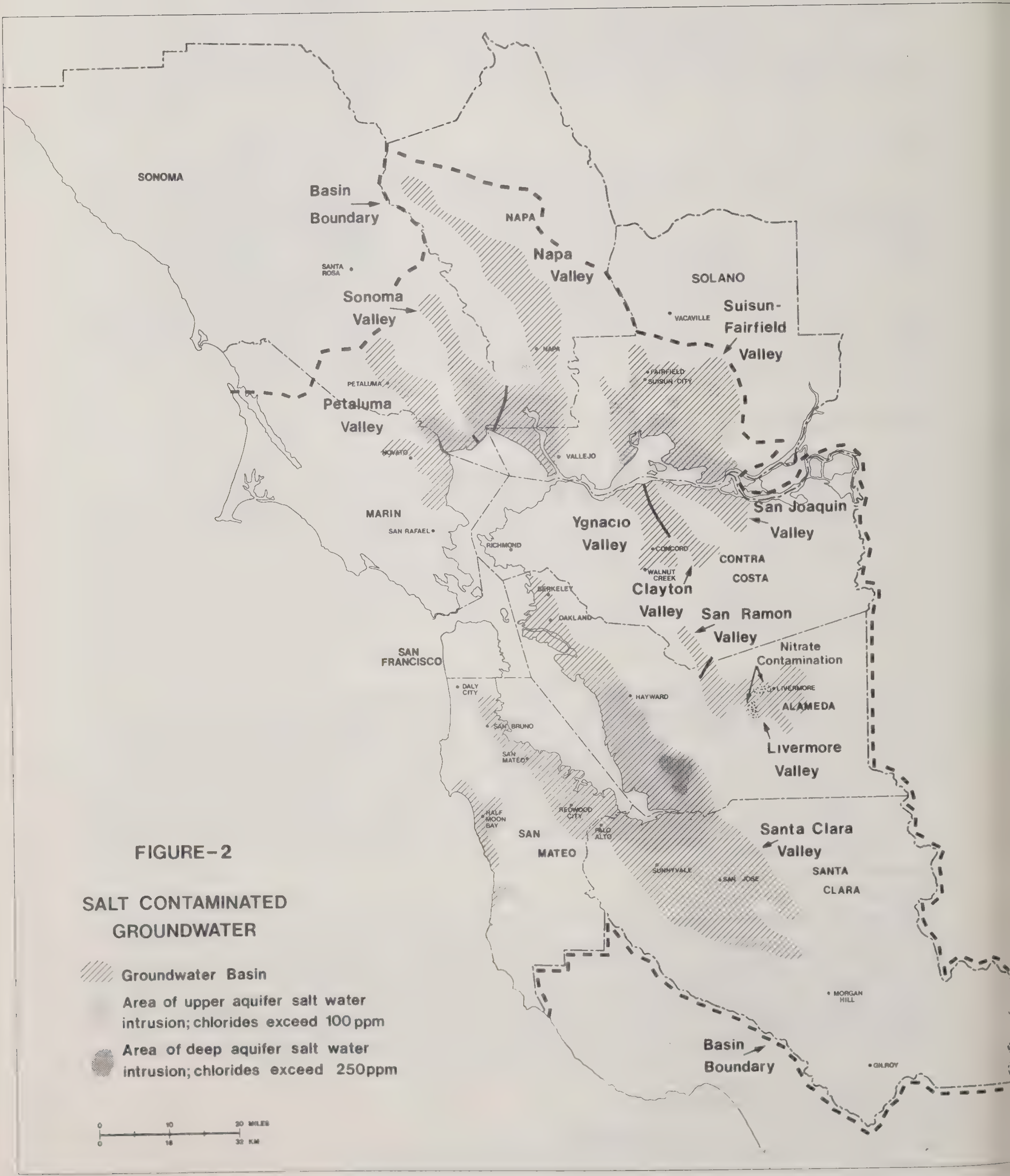

FIGURE-2

SALT CONTAMINATED GROUNDWATER

CURRENT AND PROJECTED EXTENT OF THESE PROBLEMS

Following is a presentations of groundwater problems in the Bay Area. Limited resources prevented a definitive survey and thus all known problem areas may not be identified. Also, aggressive groundwater recharge programs by a number of agencies may have altered in the extent of some problem areas. The current drought, with high demands placed on groundwater supplies, further complicates the picture and it may be safely stated that no one has a current, accurate assessment of all groundwaters in the Bay Area.

Many water districts in the Bay Area rely on groundwater as the source of water or to supplement other water supplies. Table 1 lists these agencies. In addition, most areas that are not serviced by any water district use wells or groundwater. This reliance on groundwater has resulted in overdrafts[a] and subsequent intrusion in localized areas. Figure 2 at the end of this section and the Figures and Tables in Appendix A summarize the status of those areas of concern. Table 2 shows current estimates of overpumping in the Bay Area.

South Bay Area

The groundwater levels in the deep aquifers of the Santa Clara Valley area had dropped 100 feet by 1934. This overdraft has resulted in subsidence of the ground due to the compaction in the deep clay layers between these aquifers. The resulting inland incursion of tidal waters has caused salt water intrusion of several miles extending from San Lorenzo, south by San Jose, and north to Palo Alto (Tolman and Poland, 1940).

The subsidence in the San Jose Area had stopped due to the aggressive groundwater recharge program of the Santa Clara Valley Water District (SCVWD). In addition, the overdraft had been reduced from 100 feet to 70 feet by 1973 and the contaminant in the shallow aquifers (those less than 150 feet from the surface) has receded (SCVWD, 1973). Deeper aquifers in this area do not appear to be contaminated. The SCVWD established well construction and abandonment standards to eliminate the intrusion of brackish tidal water into the deeper fresh water aquifers through wells. Recently, direct contimination threatened groundwater supplies in the Palo Alto area. The District initiated a program, supported by a grant from the Regional Water Quality Control Board, to inject reclaimed wastewater into the shallow aquifers through wells. The injected water will set up a hydraulic barrier against intrusion (SCVWD, 1976). Therefore, the San Jose and Palo Alto areas appeared to have the salt intrusion problem under control. However, the SCVWD has warned that continued drought conditions beyond 1977 may result in a recurrence of subsidence and has asked for voluntary cutbacks of 25% in water use. The approval of the San Felipe project to distribute imported water in the Valley should alleviate this water shortage.

---

[a] For further information on overpumping and safe well yields, refer to the EMP Management Plan on Water Conservation, Reuse, and Supply.

Table 2

REPORTED GROUNDWATER USE, 1975-76[a]

Groundwater Basin	Average Water Movement, Acre-feet/year: Safe yield[b]	Withdrawals[c]	Total Recharge[d]
Contra Costa County Total	?	?	?
Brentwood	?	5,600	?
Pittsburg	?	?	?
Clayton Valley	?	?	?
Ygnacio Valley	?	?	?
San Ramon Valley	?	?	?
Alameda County Total			
Niles Cone	10,000	21,400	24,600[e]
Livermore-Amador Valley	20,200[f]	25,000	23,400[f]
Santa Clara Valley Total	161,700	200,000	238,000
North	97,400	unc.	unc.
South	64,300	unc.	unc.
San Mateo County Total	?	14,000	?
Daly City	6,300	6,000	?
Half Moon Bay	?	5,800	?
Bayside	?	2,200	?
San Francisco County Total	?	0	?
Marin County Total	?	2,200	?
Sonoma County Total	53,000	50,500	?
Sonoma Valley	unc.	unc.	?
Petaluma Valley	unc.	unc.	?
Napa Valley Total	24,000	10,000	?
Solano County Total	32,900	59,360	?
Suisun-Fairfield Valley	7,900	unc.	?

[a]Source: Water Conservation, Reuse and Supply Study, ABAG.

[b]Generally based upon natural recharge.

[c]Reported by water supply agencies and estimated from agricultural application.

[d]Includes natural and known artificial recharge.

[e]Only 10,000 acre-ft/yr. useable portion of basin.

[f]Includes high salt and nitrate waters.

The local contamination of deeper aquifers in the Centerville area of Fremont appears to be virtually irreversible (Hogenson, et al., 1967). The Alameda County Water District has adopted well construction and abandonment standards. It also has developed a program using gravel pits to percolate water into the shallow groundwater basins to alleviate problems in this area.

The Livermore Valley in Alameda County is apparently subject to groundwater contamination by salts originating from the land disposal of Alameda County Flood Control District Zone 7 have demonstrated a high correlation between treated wastewater disposal activities and locations of groundwater containing high nitrate concentrations.

Richardson and San Rafael Bay Areas

To date, isolated overdrafts in the northern Bay may have resulted in localized areas of salt water encroachment in shallow aquifers near Richardson Bay, Ross Valley and San Rafael in Marin County. Areawide overdrafts may occur if the groundwater were to be used. Such use probably would result in salt water encroachment in the deep aquifers (Hogenson, et al., 1967). However, no problems have occurred during the 1976-77 drought since groundwater is not being used. No groundwater recharge programs are in effect.

San Pablo Bay Area

In the aquifers adjacent to San Pablo Bay, overdraft has occurred in the southern portions of the Napa-Sonoma Valley. The mechanism of intrusion is similar in these areas. Heavy summer pumping in these areas has caused the groundwater level to drop below sea level. The reversed hydraulic gradient has allowed the saline water in the rivers to intrude inland. During winters of normal rainfall, the normal bayward hydraulic gradient acts to retard the intrusion and forms a fresh water film over the brackish water (California Department of Water Resources, 1975). There is also an area of high chlorides in the Petaluma Valley. The salty water may be related to overdraft and resulting intrusion or to the water being trapped in these marine sediments when they wre originally deposited.

Sonoma County and the State Department of Water Resources are conducting a detailed study to determine safe well yields, areas for potential groundwater recharge and whether the intrusion is increasing or decreasing. Their management program will depend on the results of this study, due to be completed by 1985.

Napa County had begun an experiemental program to recharge water below Rector Dam between Yountville and Oakville into the Napa Valley groundwater basin. The program has been delayed due to the lack of water for recharge.

Suisun Bay Area

The main aquifers adjacent to Suisun Bay are those near Pittsburg, near Fairfield, and in Ygnacio Valley. No overdraft has occurred in the

Ygnacio Valley are due to the Contra Costa Canal Project. Overpumping at Pittsburg has caused the infiltration of Sacramento River water into the groundwater. The Contra Costa Canal project and the regulation of the Sacramento River with Shasta Dam have remedied this problem. The overdraft in the Fairfield areas appears to have been remedied by the Solano project that provides water from Lake Berryessa via the south Utah Canal (Hogenson, et al., 1967). In fact, the Suisun Valley area has had problems with a high groundwater table that has affected the orchards in the area. Pumping has been used to drop the water table. Little is known of the effects of the 1976-77 drought on this area. Using groundwater to enhance the water quality of the Suisun Marsh has even been considered. However, decreases in fresh water flows through the Delta[a] could lead to possible problems, especially east of Pittsburg.

The California Water Service Company drilled wells in the early 1930's, in the area northeast of Concord near Port Chicago. The water was potable, but hard, with high amounts of dissolved solids. The well area was a poor groundwater area, and problems of salt water intrusion occurred. In 1961 the Contra Costa Canal was constructed and the wells were abandoned. As the recent drought situation worsened, the CCCWD began looking for new water sources. CCCWD found that the Contra Costa Canal System has reconstituted the groundwater. Initial tests show that the quality of the water has improved due to local irrigation with good quality water, however it is not known if the quantity is sufficient. Test wells will be drilled to check both the quantity and quality of the water in the old well area.

Solano County is the only county in the Bay Area that does not have well construction and abandonment standards since there have been no problems with the wells in their jurisdiction. The county does not have any groundwater recharge program and county staff are not concerned about salt water intrusion.

Although Contra Costa County also has no recharge program at the present time, county staff is concerned about brackish Delta water intruding into groundwater used for agriculture east of Pittsburg. No problems have occurred to date.

Sonoma Coastal Area

The main area of salt water intrusion is the Russian River Basin near Jenner. When flow of the Russian River is low, natural recharge decreases, and the intrusion of sea water into this tidal basin increases.

The program of Sonoma County was discussed in the earlier section on the "San Pablo Area."

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[a] For further information refer to the special study on Delta outflows.

Marin Coastal Area

Salt water intrusion is suspected into Drakes Estero basin at Drakes Bay, into Bolinas Lagoon basin at Bolinas Bay and into Frank Creek basin west of Sausalito. As with the Marin shore on the Bay side, the County does not consider intrusion to be a significant problem.

San Mateo Coastal Area

Salt water intrusion is suspected near Tunitas Creek. Chlorides also exceeded 100 ppm in the Half Moon Bay area.

No significant contamination of local domestic wells has occurred to date because most of the wells on the coast are very shallow and do not extend below sea level. There are no groundwater recharge programs at the present time.

The protection of groundwaters may be regulated from two viewpoints. One is the intrinsic value of groundwaters as a natural resource. All groundwaters in the Bay Area fall into this category and their protection is mandated by the Porter-Cologne Act. Another viewpoint is to consider groundwaters as potable water supply sources. This category comes under the regulation of the Federal Safe Drinking Waters Act of 1974 and several State regulations, but would cover only some groundwaters.

Obviously, the two viewpoints are separated by a rather arbitrary distinction of beneficial use. The logical approach is to deal with groundwaters within context of a continuous spectrum of beneficial uses and apply pertinent regulations as needed. This implies that there should be a single, basic groundwater management or protection program that deals with all impacts upon and uses of groundwaters. The following discussion and subsequent analysis will often relate protection of groundwater quality to specific use criteria because groundwaters are not generally considered to have the intrinsic and aesthetic values associated with surface waters.

FEDERAL

The Safe Drinking Water Act, PL 93-523 addresses groundwaters. The law provides for the setting of minimum National drinking water quality standards and covers groundwaters within that context. Specifically, the Act provides for regulation and control of groundwater injection wells. No substances injurious to public health may be injected into groundwaters that are used or may be used for dringking water supplies. The State Water Resources Control Board (SWRCB) is given primary enforcement responsibility and must develop, for Federal approval, an underground injection control program. The State program must be consistent with regulations on injection issued by the EPA. At this time, the EPA has not issued a final version of its regulations and the State of California does not have a specifically matching program.

Also in response to the Safe Drinking Water Act, the EPA has issued the National Interim Primary Drinking Water Standards in 1975 for constituents that pose health hazards and has issued preliminary Secondary Drinking Water Regulations in March 1977 for chemicals that can be tested but that are not health hazards. Chlorides falls into the latter category. When the Secondary Regulations are adopted, they will supersede the U.S. Public Health Service guidelines issued in 1962. Both the regulations and the guidelines are only advisory and have no enforcement provisions. Both also set a limit on chloride concentrations of 250 ppm.

STATE

The Porter-Cologne Act of 1969 delegates to the SWRCB the authority to protect all waters of the State. The Water Quality Control Plan for the San Francisco Bay Basin presents generalized water quality objectives for groundwaters according to their intended municipal or agricultural uses. Specific aquifers have not received formal use designation. However, all treated wastewater disposal to the ground, whether by percolation or well injection is subject to control by the SWRCB. Presumably, the SWRCB would not permit injection of waters that would harm beneficial uses.

The State Department of Health has statutory responsibility for injection wells and is actively trying to develop criteria for treated wastewater injection to groundwaters. In issuing permits for ground disposal of treated wastewaters, the SWRCB consults with the Department of Health. Injection wells are a grey area of responsibility between the SWRCB and Department of Health.

SB 20-78 has incorporated the Safe Drinking Water Act of 1974 into State law and assures State compliance with the Federal regulations as they develop. The State has authority to require stricter standards than the EPA regulations. EPA primary drinking water standards, including groundwater sources, have been incorporated into Department of Health regulations. It is anticipated that these standards will be adopted by the State legislature in a few months.

With regard to existing State laws on public water supplies, Chapter 7 of the Division of the State Health and Safety Code, (Sections 4010 to 4035) authorizes the State Department of Health to regulate the quality of domestic water supplies. Part 1, Chapter 5, Subchapter 1 of Title 17 of the California Administrative Code established the quality standards for domestic water supplies and the minimum standards for monitoring of water delivered to consumers. Specifically, Section 7020 specifies gradational consumer acceptance limits for chlorides. 250 ppm is the recommended limit, while 500 ppm is the upper limit and 600 ppm is the short term limit. Table 3 provides a partial comparison of the requirements of various regulations.

The Porter-Cologne Act also deals with water wells and cathodic protection wells. The California Department of Water Resources (DWR) receives a report whenever a well is constructed, deepened, or abandoned. If the Department concludes that local standards are inadequate, it reports this to the local Regional Water Quality Control Board (RWQCB), and the State Department of Health. After a public hearing, the RWQCB may require the local agency to develop well standards. This procedure was followed for Alameda County. If standards are not adopted, the State standards are imposed. Existing local well ordinances are listed in Table 4.

These ordinances refer to standards of construction, deepening, and sealing of abandoned wells to prevent interaction between fresh groundwaters and contaminated surface or shallow groundwaters. Sealing is normally accomplished by injecting concrete grout in the well and forcing it to fill perforations in the well casing adjacent to clay layers that separate aquifers.

Table 3

LIMITS ON COMMON DISSOLVED SALTS IN WATER SUPPLIES

Regulation	Water Use	Concentrations, mg/l Total Dissolved Solids	Chloride	Nitrate
USPHS Drinking Water Standards, 1962[a]	Potable	500	250	45
EPA Interim Primary Standards, 1975[a]	Potable	500	250	45
EPA preliminary Secondary Regulations, 1977[a]	Potable	500	250	-
California Administrative Code, Title 17, Part 1, Chapter 5, Subchapter 1 and San Francisco Bay Basin Plan[b]	Potable	500[a] 1,000[c] 1,500[d]	250[a] 500[c] 600[d]	45
State Health Department proposed Primary Standards[b]	Potable	500	250	45
San Francisco Bay Basin Plan beneficial use criteria	Potable[a]	500 1,500[c]	250 1,000[c]	45
	Agricultural[b]	-	70 300-1,000[c]	-
Health risks to persons with renal disease, hypertension and heart problems.[a,e]	Potable	-	>250	-

[a]Recommended

[b]Enforceable

[c]Upper limit

[d]Short-term limit

[e]Due to associated sodium ions-from Contra Costa County Health Department bulletin.

TABLE 4: LOCAL WELL STANDARDS

County	Ordinance Number	Date Adopted	Comments
Alameda	73-68	July 17, 1973	
Contra Costa	1189	Jan. 24, 1958	
Marin	1463	1965	For domestic wells only
Napa	335	Dec. 1, 1970	
San Francisco	659	1952	
San Mateo	Ch. 5, Envir. Health Code	Feb. 11, 1977	
Santa Clara (Water District)	75-6	Oct. 14, 1975 (Amended 7-27-76)	
Solano	-	-	
Sonoma	1594	Dec. 18, 1972	

POTENTIAL MANAGEMENT PLAN ELEMENTS

SUMMARY

The following are potential actions that would alleviate present and prvent future salt contamination of groundwaters:

- o The RWQCB would establish beneficial use designations for groundwaters in the Bay Area.
- o Each agency using groundwaters would be required to prepare a water management plan.
- o There would be a zero net removal of groundwater supplies.
- o Artificial recharge may be used to balance excess withdrawal above safe yield.
- o All abandoned wells would be properly sealed and improperly constructed or damaged wells should be reconstructed or repaired.

BENEFICIAL USE

The assessment of groundwater quality is inextricably linked to present and potential uses. The protection of a groundwater must be based upon an expected level of quality. In order to tie these factors together, the RWQCB should designate the highest beneficial use for individual groundwater basins. A designation of "potable water supply" or "municipal supply" already has abundant numerical standards associated with it. A designation of "agricultural" or "irrigation" is loosely defined in the Basin Plan and corresponds to some dissovled solids standards. Three additional categories may possibly be added. One would be for industrial use where water quality is not of critical concern. A second would be as a source of surface water (e.g.: through surface springs) where a specific surface water quality must be met. The third would be a hydraulic barrier to marine water intrusion. The physical arrangements of hydraulic barrier injection and/or withdrawal would determine the required quality.

GROUNDWATER MANAGEMENT PLAN

A groundwater management plan would clearly establish the uses of a groundwater and methods to be employed for protection of the supply. Each agency using groundwaters would be required to prepare a management plan for RWQCB approval. If more than one agency or industry are tapping a groundwater, a joint powers agency could prepare the plan. The RWQCB would undertake the preparation if a suitable local agency could not be identified.

The management plan would address the topics of natural fresh water recharge, safe yield, beneficial use, artificial recharge and emergency use. The plan must of necessity establish a clearer definition of a

groundwater body's location than is currently found in the Basin Plan. It would be the purpose of the plan to match withdrawals from a groundwater basin with natural and artificial recharge in order to protect beneficial uses from salt intrusion. (Artificial recharge and salt additions from a substantial number of septic tanks would be included.)

The most far-reaching implication of a groundwater management plan is water rights allocations. Historically, surface waters were free until increased usage either restricted some users or exceeded a limited supply. A similar situation in groundwater use is now being approached. Population growth and high demands upon limited surface waters are putting pressure on groundwater use. However, groundwater is a limited supply and excessive withdrawal is an invitation to salt intrusion.

ZERO NET WITHDRAWAL

The concept of zero net withdrawal stems from the idea that any withdrawal in excess of natural and artificial recharge will lower the groundwater table. This will provide the physical opening for salt intrusion. In order to protect the quality and beneficial uses of groundwaters, the RWQCB would have to forbid the excess withdrawals that would allow salt intrusion to occur. The methods employed by water users to achieve a zero net withdrawal would be incorporated in the groundwater management plan.

The concept of zero net withdrawal does not allow for other forms of salt intrusion prevention. These others forms principally consist of creating a hydraulic barrier or mound between fresh groundwaters or slaine waters, or they consist of creating a constantly pumped trough that intercepts the saline water as it moves inland. These are temporary measures at best.

Groundwater resources have a finite capacity. Pumping in excess of natural plus artificial recharge must in the long term "empty" the well and the salt intrusion barriers would be, figuratively, protecting a dry hole. Short-term overpumping such as during a drought period, would be permissible if the water were to be later replaced.

The concept of zero net removal would be valid only over extended time periods. Within certain physical limitations, groundwater basins could be recharged above net withdrawal during normal years. This would permit some banking of water for use during drought years.

Under Section 2100 of the Water Code, the SWRCB has the authority to use adjudication procedures when groundwater basins are in trouble. The SWRCB can file action in court to restrict pumping or impose intrusion control measures.

ARTIFICIAL RECHARGE

Artificial recharge may be used to balance excess withdrawal above natural safe yield. Recharge may be with fresh waters or reclaimed

wastewaters. The quality of recharge waters shall be such as to preclude impairment of beneficial uses of groundwaters. Existing and new Department of Health and SWRCB regulations on quality or method of recharge would be followed.

Where septic tank leachate or irrigation drain water can reach a groundwater basin, the effects of these wastes upon water quality would be taken into consideration. Increases in nitrate levels from these wastes would be considered a restraint on potable water use and must be considered in the total calculations of recharge water quality. Artificial drains for the agricultural leachate or prohibition on further septic tank construction may be needed to prevent groundwater supplies from deteriorating.

SEAL ABANDONED WELLS

Abandoned wells have been found to be a source of groundwater pollutants. All Bay Area counties except Solano have well construction and abandonment standards. It is proposed that all abandoned wells must be sealed to prevent surface waters from contaminating groundwaters. If the wells are on public or abandoned property, then they would be sealed at county or water district expense.

SELECTION OF ALTERNATIVES

The development of the preceeding potential actions was based upon a cursory survey of the status of Bay Area groundwater basins. These actions are reasonable in view of the perceived problems. However, groundwater management is incredibly complex; tangled in technical, political and legal factors. Any substantial management recommendations should be based upon the most authoritative, current, and complete set of facts that are obtainable. Thus, before specific management alternatives are selected and implemented, it would be mandatory to conduct a scale investigative effort to obtain the necessary information. This information would include, but not be limited to, technical details about specific aquifers, current use activities, current water agency management program and policies, and legal constraints to groundwater management. Such an investigation is beyond the resources of this program and would require active participation by all water regulatory and supply agencies in the Bay Area.

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Webster, D. A., 1972b. Map Showing Areas in the San Francisco Bay Region Where Nitrate, Boron, and Dissolved Solids in Ground Water May Influence Local or Regional Development, U.S. Geological Survey Miscellaneous Field Studies Map MF-432.

APPENDIX A

STATUS OF SEA-WATER INTRUSION[a]

[a] Source: California Department of Water Resources, 1976

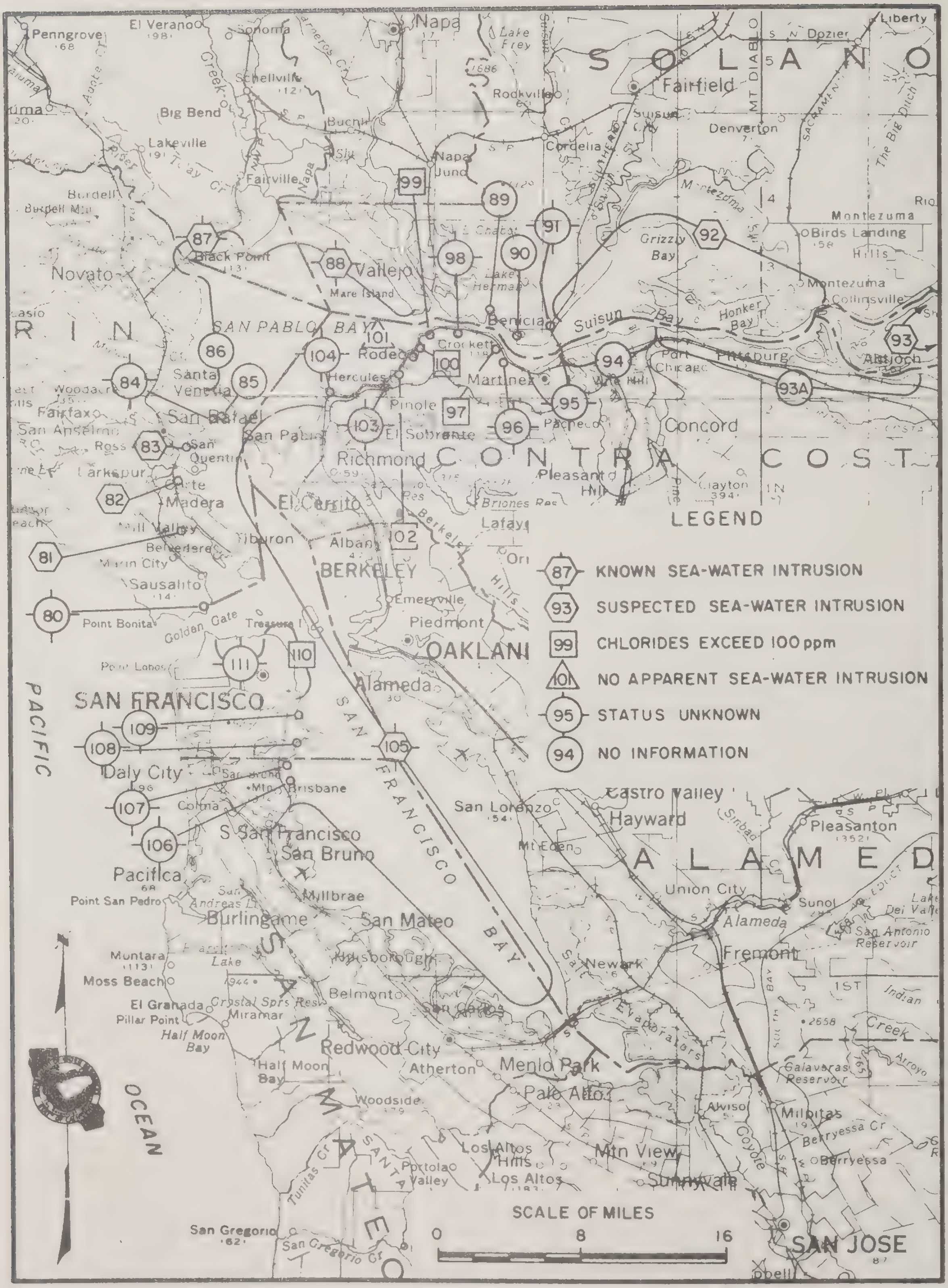


Figure A1. STATUS OF SEA-WATER INTRUSION, SAN FRANCISCO BAY AREA COUNTIES 1970-1971

Table A1. STATUS OF SEA-WATER INTRUSION, SAN FRANCISCO BAY AREA

Basin No.	Basin Name	1953-55	1970-71
		MARIN COUNTY	
80	Horseshoe Bay	Status unknown	Status unknown
81	Richardson Bay	No apparent sea-water intrusion	Suspected sea-water intrusion
82	Ross Valley	No apparent sea-water intrusion	Suspected sea-water intrusion
83	San Rafael	Chlorides exceed 100 ppm	Suspected sea-water intrusion
84	Marin Island	Status unknown	Status unknown
85	San Pedro Point	No apparent sea-water intrusion	No information
86	Novato Valley	Chlorides exceed 100 ppm	No information
		MARIN AND SONOMA COUNTIES	
87	Petaluma Valley	Known sea-water intrusion	Area increasing
		SONOMA, NAPA, AND SOLANO COUNTIES	
88	Napa-Sonoma Valley	Known sea-water intrusion	Area may be increasing
		SOLANO COUNTY	
89	Southampton Bay	Chlorides exceed 100 ppm	No information
90	Benicia	Chlorides exceed 100 ppm	No information
91	Sulphur Springs	Status unknown	Status unknown
92	Suisun-Fairfield Valley	Suspected sea-water intrusion	Area may be decreasing
		SOLANO, SACRAMENTO, SAN JOAQUIN, AND CONTRA COSTA COUNTIES	
93	Sacramento-San Joaquin	Chlorides exceed 100 ppm	Suspected sea-water intrusion in several areas
		CONTRA COSTA COUNTY	
93A	Pittsburg Plain	Known sea-water intrusion in the 1930s	No information

Table A1. STATUS OF SEA-WATER INTRUSION, SAN FRANCISCO BAY AREA (Cont.)

Basin No.	Basin Name	1953-55	1970-71
	CONTRA COSTA COUNTY (Cont.)		
94	Clayton-Ygnacio Valley	Known sea-water intrusion in the 1930s	No information
95	Arroyo del Hambre	Status unknown	Status unknown
96	Little Bull	Status unknown	Status unknown
97	Big Bull	Status unknown	Chlorides exceed 100 ppm
98	Crockett	Status unknown	Status unknown
99	Canada del Cierbo	Status unknown	Chlorides exceed 100 ppm
100	Oleum	Status unknown	Chlorides exceed 100 ppm
101	Rodeo	Status unknown	No apparent sea-water intrusion
102	Refugio	Status unknown	Chlorides exceed 100 ppm
103	Pinole	Status unknown	Status unknown
104	Sobrante	Status unknown	Status unknown
	CONTRA COSTA, ALAMEDA, SANTA CLARA, AND SAN MATEO COUNTIES		
105	Santa Clara Valley	Known sea-water intrusion	Area increasing
	SAN MATEO COUNTY		
106	Guadalupe	Status unknown	Status unknown
	SAN FRANCISCO COUNTY		
107	Visitacion	Status unknown	Status unknown
108	Potrero	Status unknown	Status unknown
109	Islais	Status unknown	Status unknown
110	Market Street	Chlorides exceed 100 ppm	Area increasing
111	Fort Mason	Status unknown	Status unknown

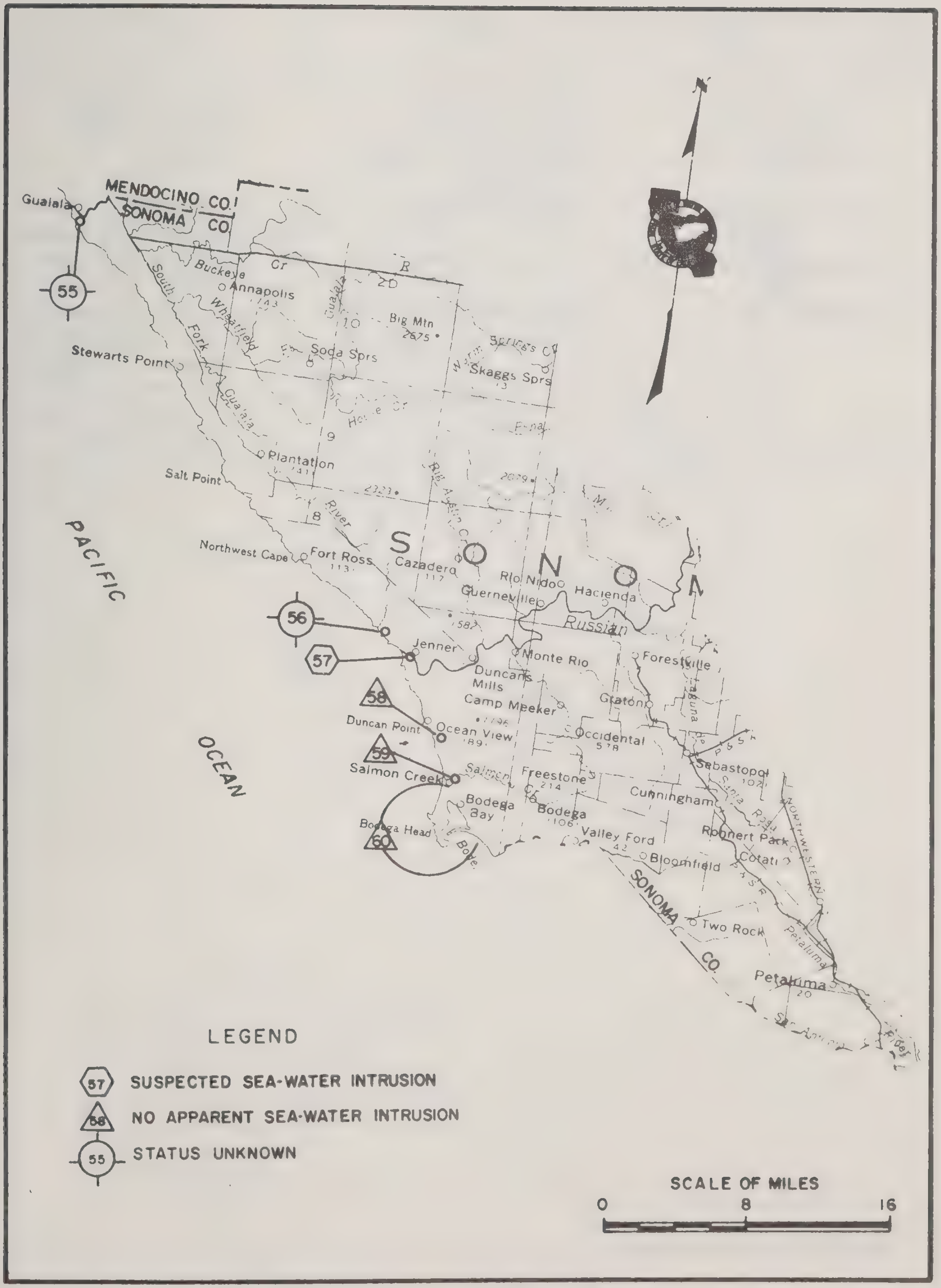


Figure A2. STATUS OF SEA-WATER INTRUSION, SONOMA COUNTY 1970-1971

Table A2. STATUS OF SEA-WATER INTRUSION, SONOMA COUNTY (COASTAL)

Basin		1953-55	1970-71
No.	Name		
55	Gualala River	Status unknown	Status unknown
56	Russian Gulch	Status unknown	Status unknown
57	Russian River	Suspected sea-water intrusion	No change
58	Scotty Creek	Status unknown	No apparent sea-water intrusion
59	Salmon Creek Valley	Status unknown	No apparent sea-water intrusion
60	Bodega Bay	Chlorides exceed 100 100 ppm	No information on area degraded in 1954. No apparent sea water intrusion in remainder of basin

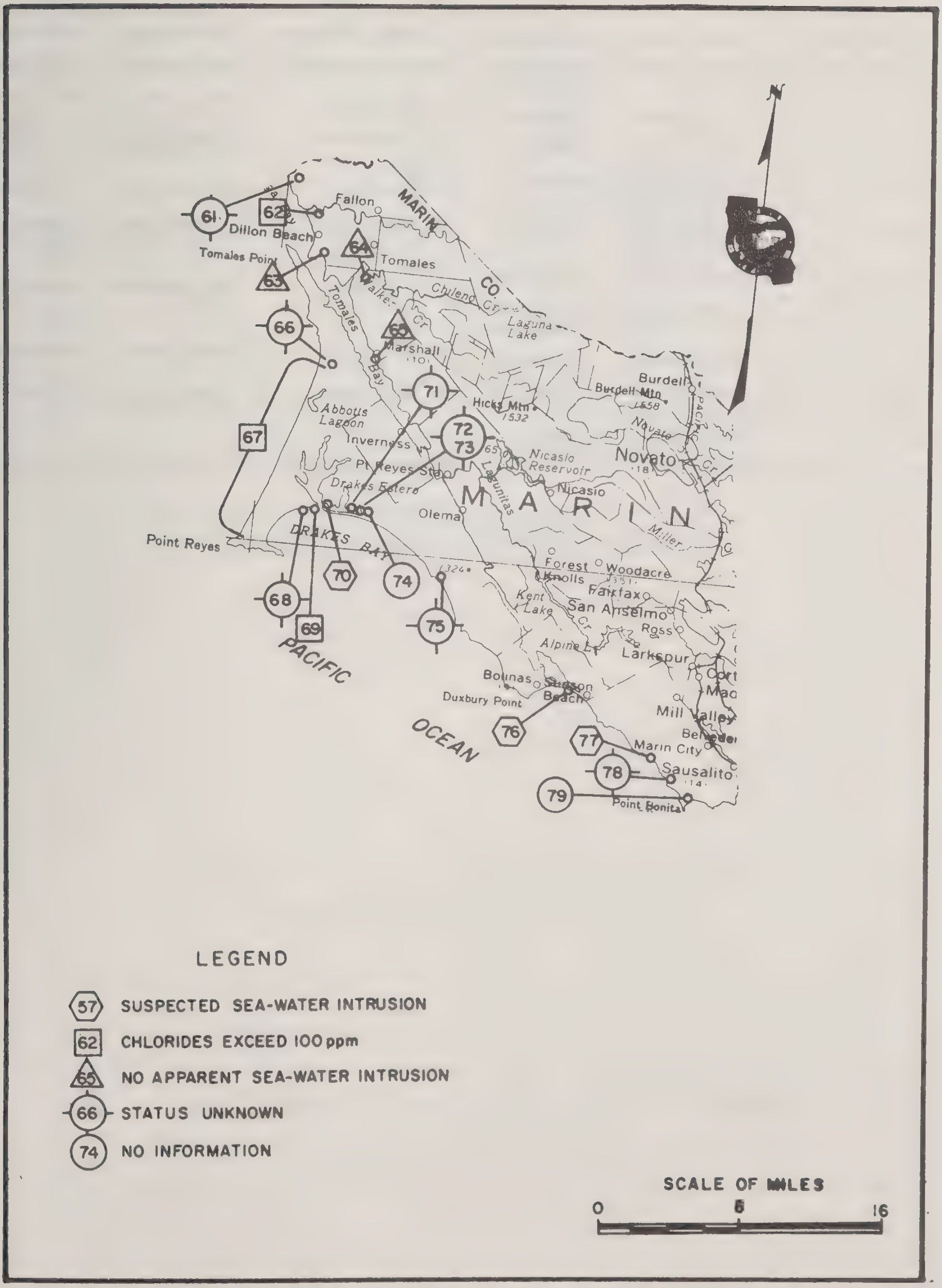


Figure A3. STATUS OF SEA-WATER INTRUSION, MARIN COUNTY 1970-1971

Table A3. STATUS OF SEA-WATER INTRUSION MARIN COUNTY (COASTAL)

Basin No.	Basin Name	1953-55	1970-71
61	Estero Americano	Status unknown	Status unknown
62	Estero de San Antonio	Status unknown	Chlorides exceed 100 ppm
63	Sand Point	Status unknown	No apparent sea-water intrusion
64	Walker Creek	No apparent sea-water intrusion	No change
65	Tomales Bay	No apparent sea-water intrusion	No change
66	Kehoe Creek	Status unknown	Status unknown
67	Point Reyes Sand Dunes	No apparent sea-water intrusion	Chlorides exceed 100 ppm
68	Drakes Bay	Status unknown	Status unknown
69	Point Reyes	Status unknown	Chlorides exceed 100 ppm
70	Drakes Estero	No apparent sea-water intrusion	Suspected sea-water intrusion
71	Estero de Limantour	Status unknown	Status unknown
72	Glenbrook Creek	Status unknown	Status unknown
73	Muddy Hollow	Status unknown	Status unknown
74	Laguna Ranch	No apparent sea-water intrusion	No information
75	Bear Valley	Status unknown	Status unknown
76	Bolinas Lagoon	No apparent sea-water intrusion	Suspected sea-water intrusion
77	Frank Creek	Chlorides exceed 100 ppm	Suspected sea-water intrusion
78	Elk Valley	Status unknown	Status unknown
79	Rodeo Lagoon	No apparent sea-water intrusion	No information

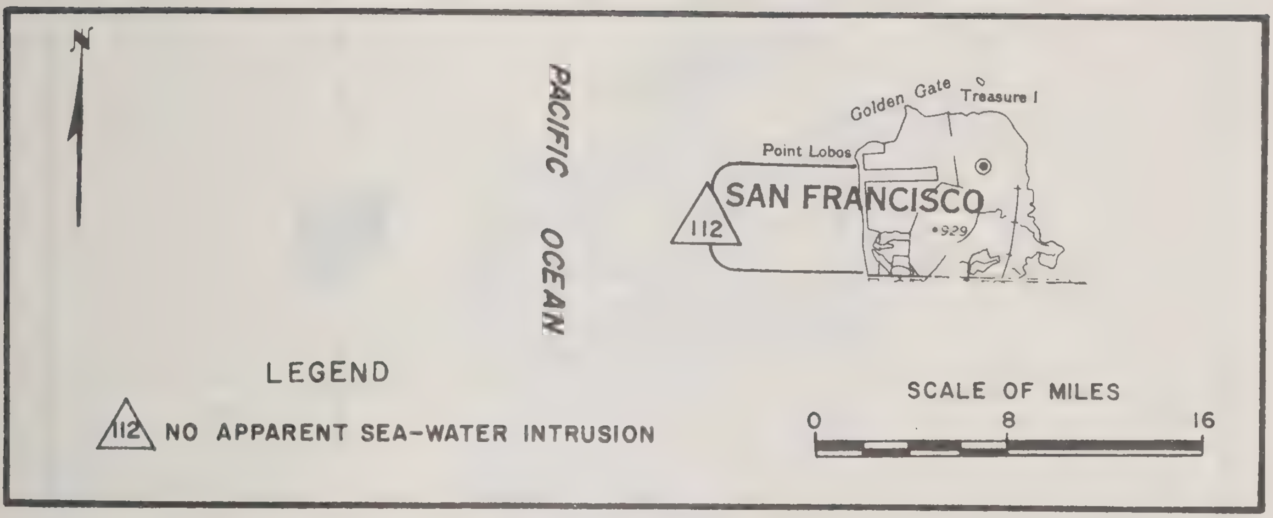


Figure A4. STATUS OF SEA-WATER INTRUSION, SAN FRANCISCO COUNTY (COASTAL) 1970-1971

Table A4. STATUS OF SEA-WATER INTRUSION, COASTAL SAN FRANCISCO COUNTY

Basin		1958	1970-71
No.	Name		
112	Merced Valley	No apparent sea-water intrusion	No change

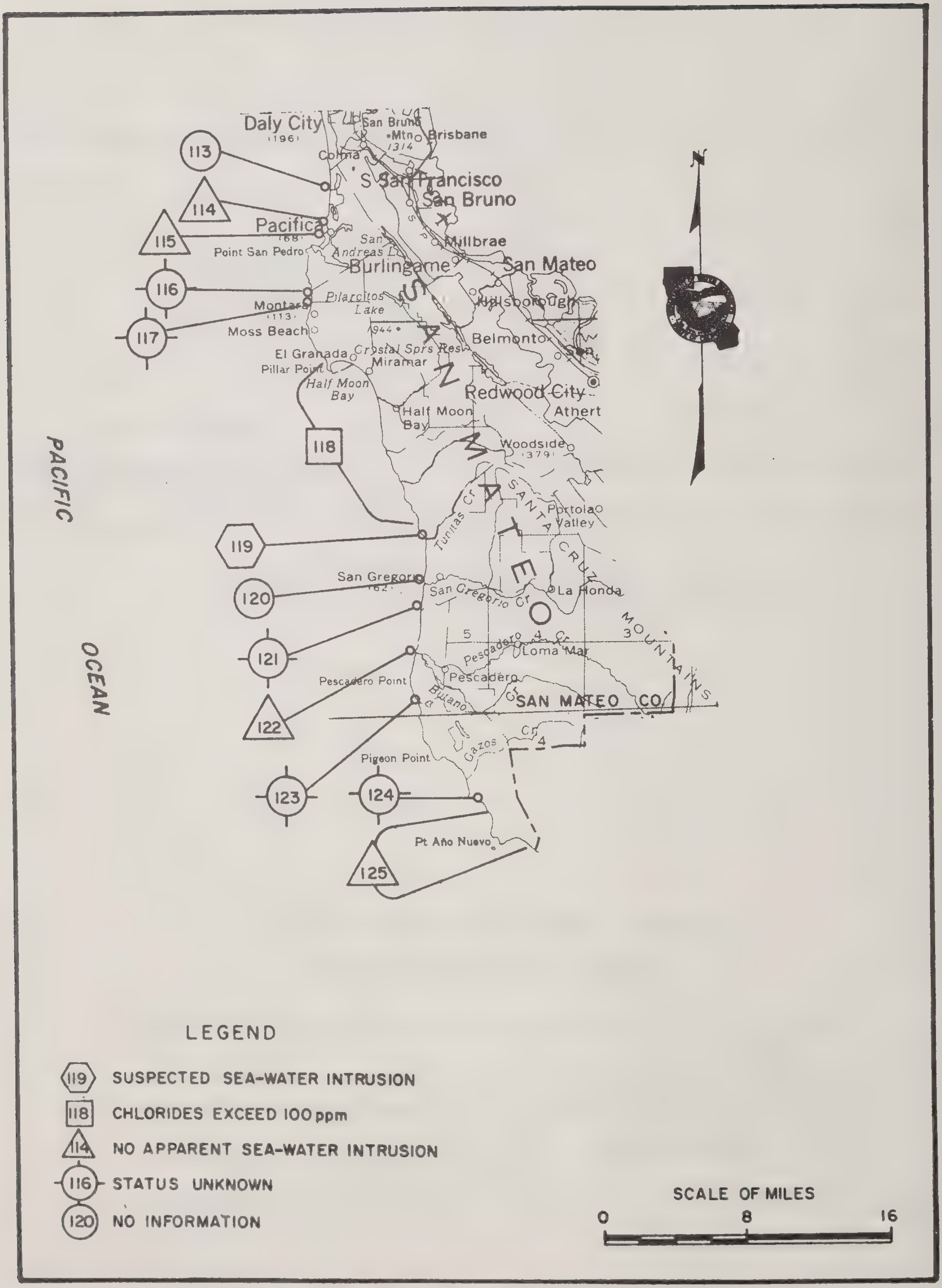


Figure A5. STATUS OF SEA-WATER INTRUSION, SAN MATEO COUNTY (COASTAL) 1970-1971

Table A5. STATUS OF SEA-WATER INTRUSION, COASTAL SAN MATEO COUNTY

Basin No.	Basin Name	1953-55	1970-71
113	Sharp Park Terrace	Chlorides exceed 100 ppm	No information
114	Calera	No apparent sea-water intrusion	No change
115	San Pedro	No apparent sea-water intrusion	No change
116	Montara Terrace	Status unknown	Status unknown
117	Montara Point	Status unknown	Status unknown
118	Half Moon Bay Terrace	Chlorides exceed 100 ppm	No change
119	Tunitas Creek	Status unknown	Suspected sea-water intrusion
120	San Gregorio Creek	Chlorides exceed 100 ppm	No information
121	Pomponio	Status unknown	Status unknown
122	Pescadero	No apparent sea-water intrusion	No change
123	Los Frijoles	Status unknown	Status unknown
124	White House Creek	Status unknown	Status unknown
125	Ano Nuevo Terrace	Status unknown	No apparent sea-water intrusion

WATER QUALITY MANAGEMENT PLANS

FURTHER S.F. BAY
MODELING RESULTS

TECHNICAL MEMORANDUM NO. 21

JULY 5, 1977

This memo is an update and refinement of Water Quality Management Plans Technical Memorandum No. 19: Preliminary S.F. Bay Modeling Results, June 7, 1977.

Attached are San Francisco Bay Water Quality Model results for three hydrologic conditions -- summer, winter with no storm runoff, and winter with storm runoff; for 1975 and 2000. For each of these conditions, the quantity and quality of Delta outflow, ocean background levels, and (for storm runoff) the intensity of the storm were chosen to represent conservative, but not extreme, conditions. The constituents modeled were total nitrogen, total phosphorous, chlorides, BOD5, and dissolved oxygen. Discussion of the choice of constituents is found in Technical Memo No. 19.

Assumptions behind S.F. Bay Water Quality Modeling Results

Wastewater pollutant loadings were taken from the Water Quality Management Plans Technical Memorandum 15: Estimated Municipal and Non-Discrete Industrial Wastewater Loads in the S.F. Bay Region, Revised Draft, May 31, 1977; and 18: Estimated Industrial Wastewater Loads in the S.F. Bay Region, Draft, May 31, 1977. Except where otherwise indicated, Best Available Treatment (BAT) loadings were used in the industrial projections, along with the ABAG Base Case 1 ("High") projections. Surface runoff polluant loadings were taken from individual County reports as summarized in Environmental Management Program Surface Runoff Brief 2, Pollution Problems, June 22, 1977.

Examination of available data indicated a large variation in the quantity and quality of Delta inflows and outflows. For summer (dry season) conditions, Delta outflow was set at 4400 cfs; while winter outflow was 31,600 cfs. Table 1 summarizes the flows and constituent loadings of the inflowing rivers: The Sacramento, Mokelumne, and San Joaquin.

TABLE 1

	FLOW (cfs)	TOTAL NITROGEN	TOTAL PHOSHOROUS	CHLORIDES	BOD5
summer					
Sacramento	7,900	0.4 mg/1	0.22	10	1.5
Mokelumne	300	0.4	0.22	10	--
San Joaquin	800	1.5	0.30	175	--
winter					
Sacramento	32,000	0.2	0.06	3	1.0
Mokelumne	1,000	0.2	0.06	3	--
San Joaquin	3,200	0.5	0.10	15	--

The Pacific Ocean was modeled with a BOD5 of 0.5 mg/1, chlorisity of 18,980 mg/1, and with nitrogen and phosphorous set to zero.

Existing sewage treatment plant and industrial outfall locations were used in the 1975 runs, while planned locations taken from "201" project reports were used in horizon year simulations.

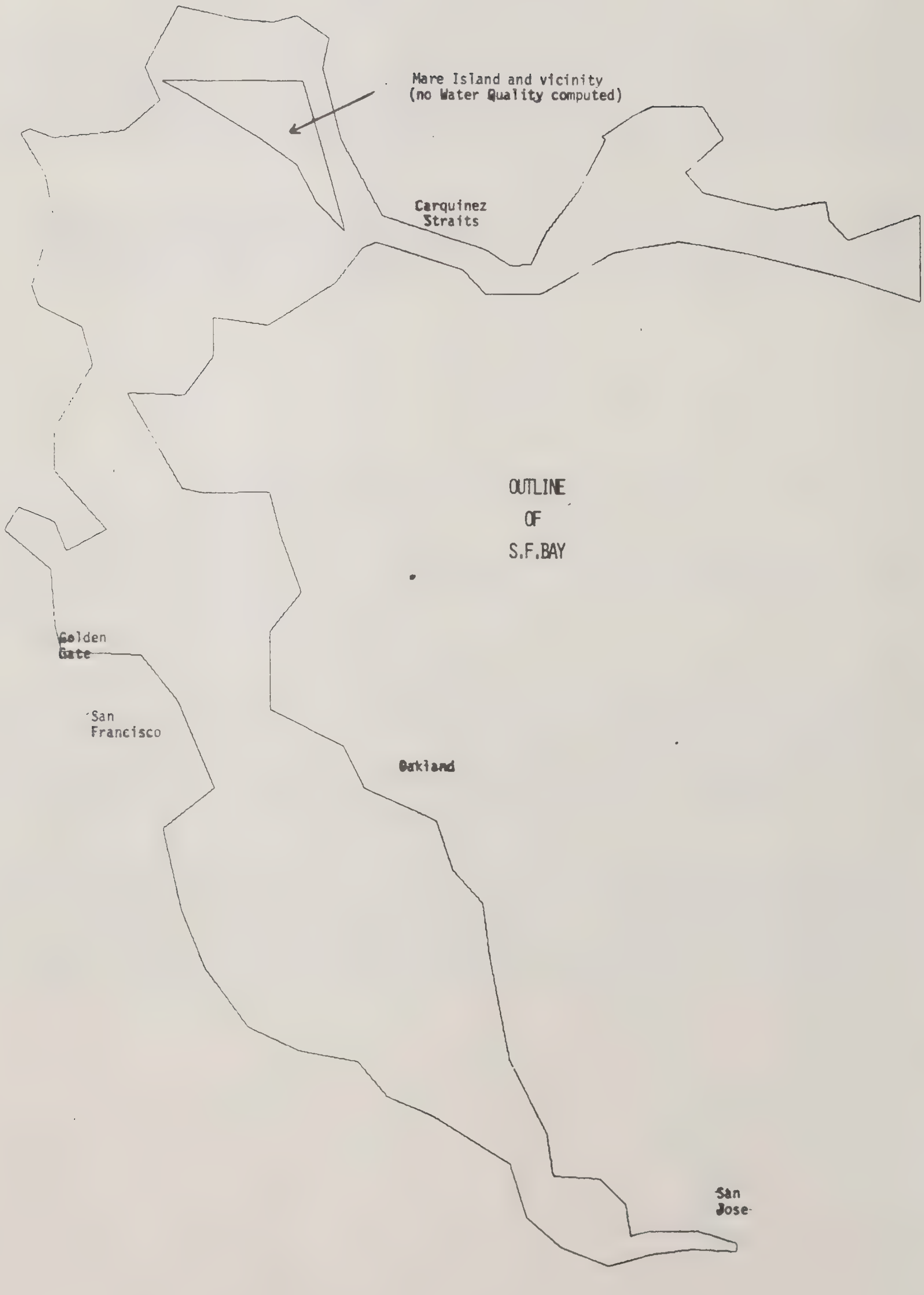
In the stormwater simulations, a three day storm which deposited 10% of the total annual precipitation was modeled. Results are presented for the conditions at the conclusion of the storm. It was assumed that the precipitation occurred uniformly over the three days, and that runoff flowed into the bay with no lag time. The assumption was also made that the quantity and quality of Delta outflow did not change during the storm.

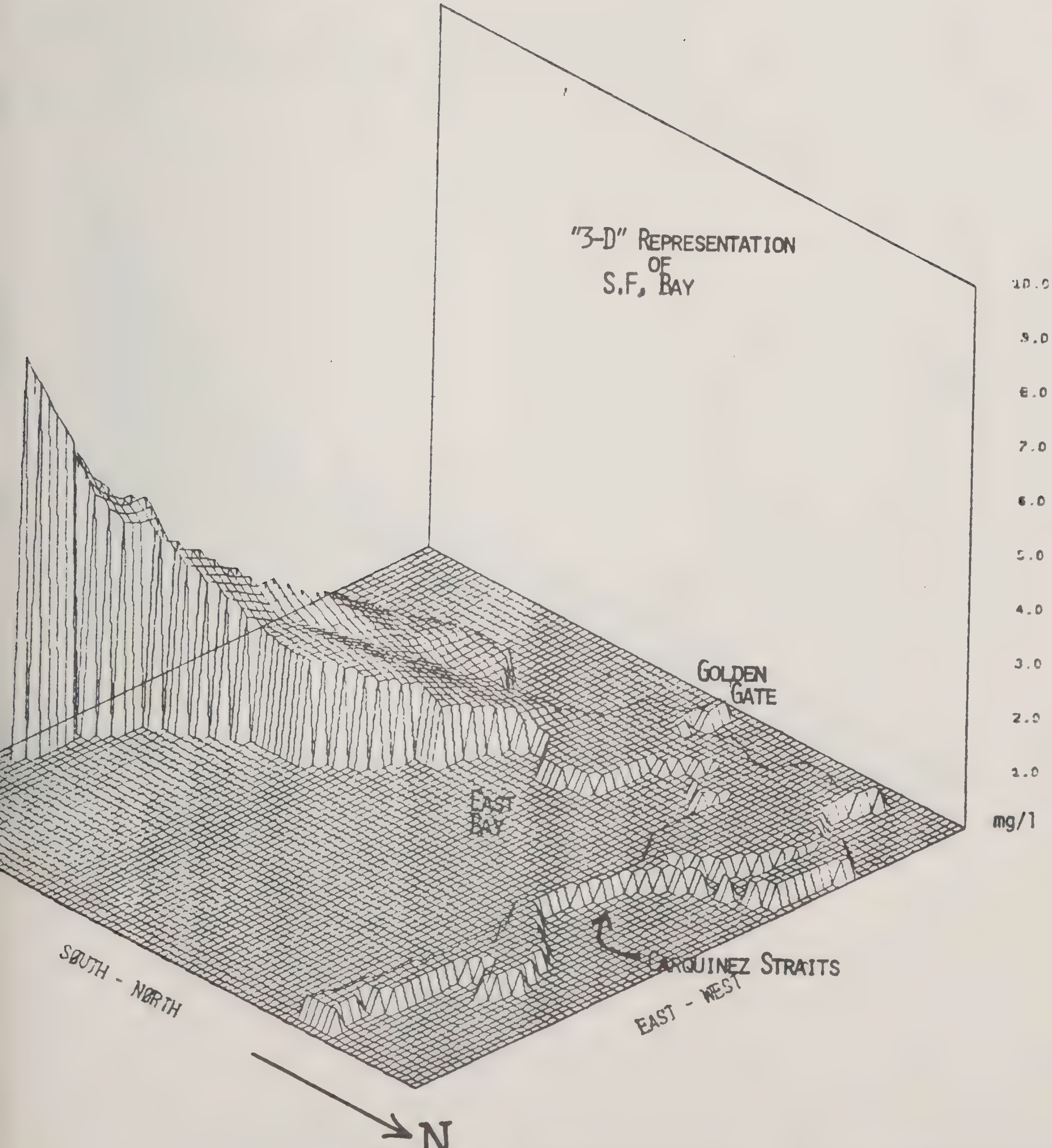
The attached summer results differ from Technical Memo 19 in two respects. The saturation value of dissolved oxygen is now computed as a function of location in the Bay; and the constituent values in the extreme South Bay (Coyote Creek, east of Calaveras Point) were not allowed to exceed the values at Calaveras Point, to reflect the lack of calibration data in that area.

FIGURES

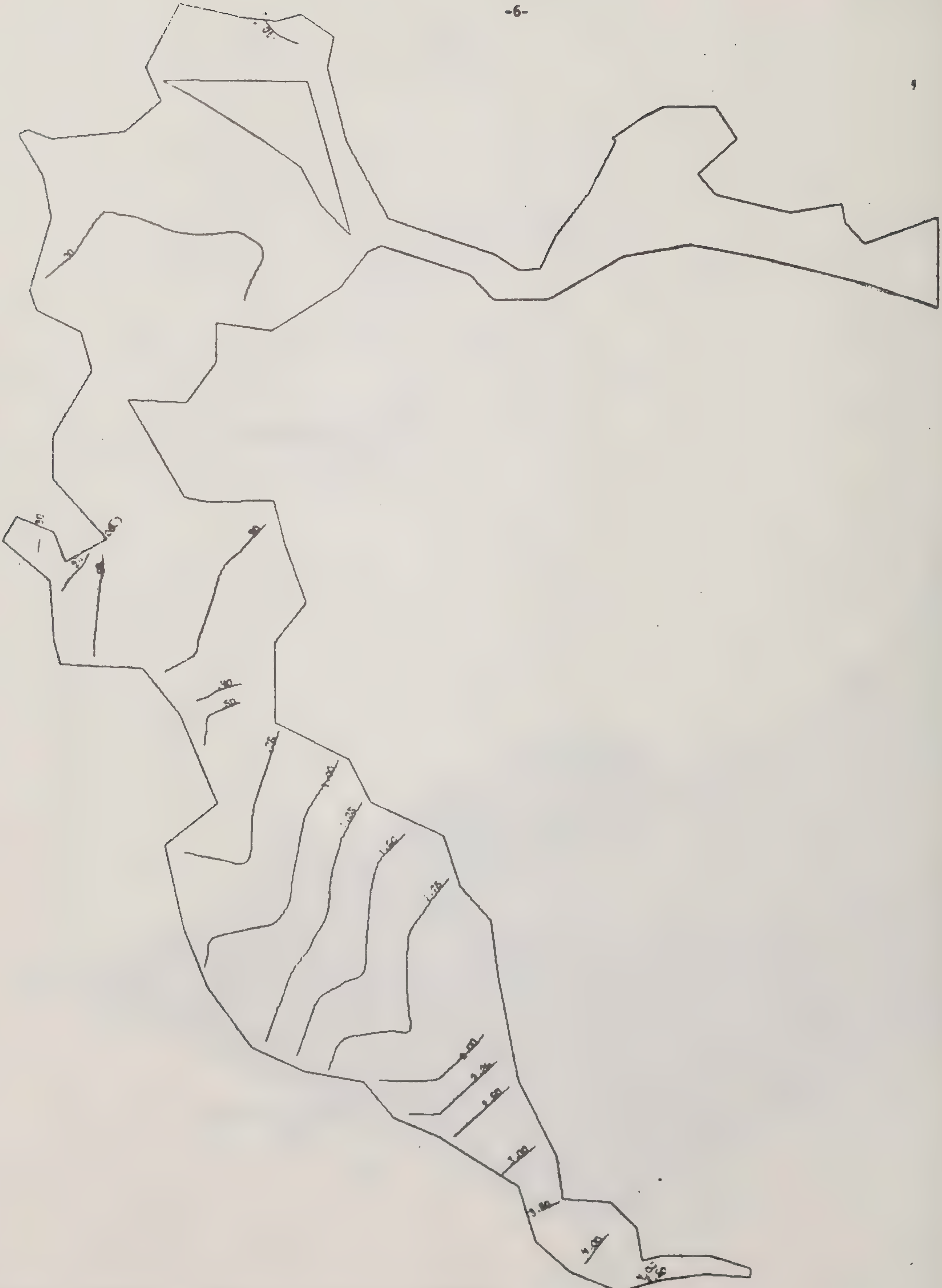
Following are computer-generated plots of SF Bay water quality, for the pollutants and conditions described in the text. The first two figures are examples, with extra labeling for clarity. Each map is presented twice--first as a standard contour plot of pollutant isopleths (lines of equal pollutant concentrations), and then in a "3-D" format. All units are mg/l (milligrams per liter).

There are three hydrologic conditions--summer (labeled"Dry Season"), winter with no precipitation (labeled "Before Storm"), and winter after three days of precipitation and stormwater runoff (labeled "After Storm").


Mare Island and vicinity
(no Water Quality computed)
Carquinez
Straits
OUTLINE
OF
S.F.BAY
Golden
Gate
San
Francisco
Oakland
San
Jose



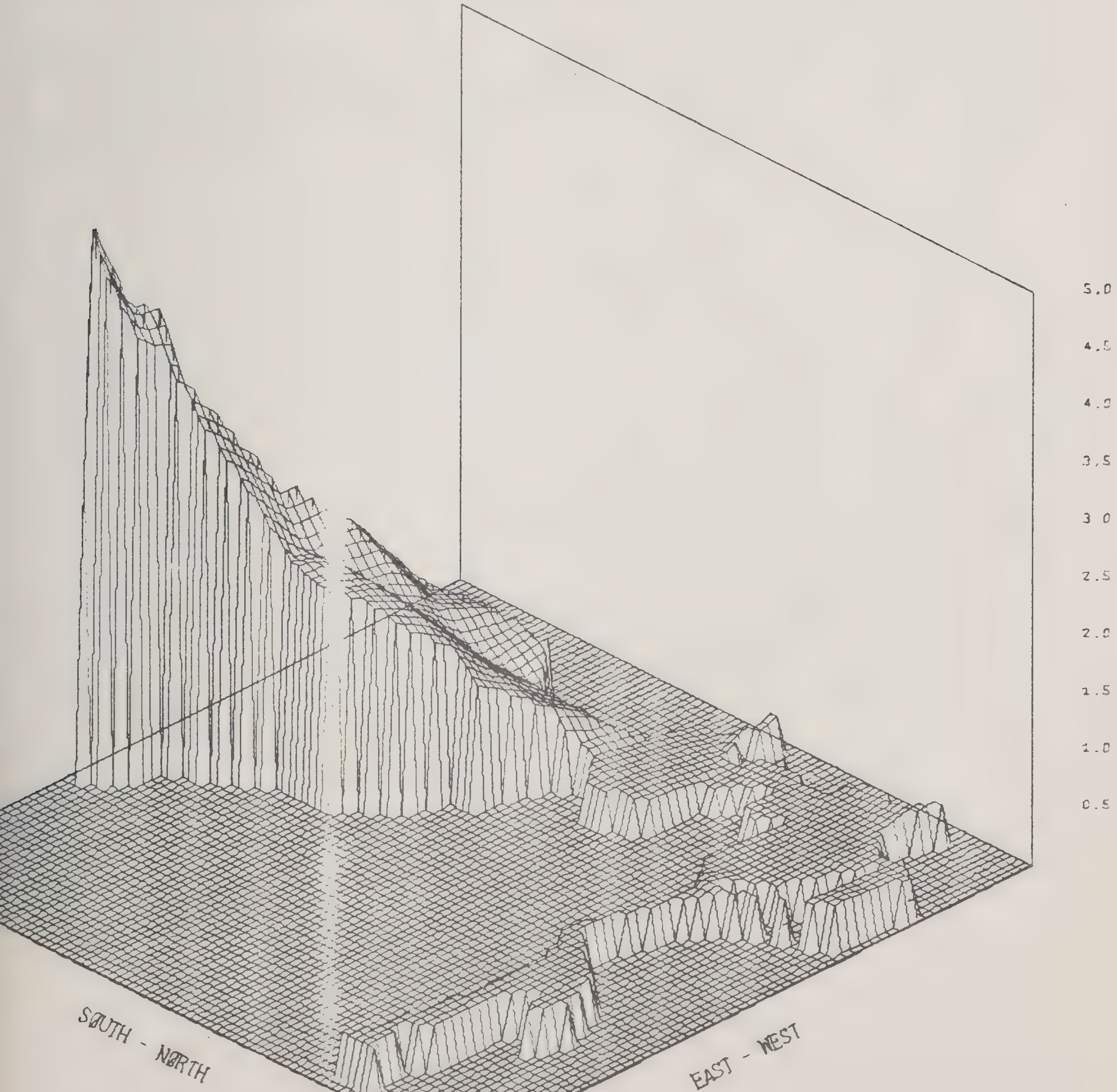
"3-D" REPRESENTATION OF S.F, BAY
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
mg/1
GOLDEN GATE
EAST BAY
CARQUINEZ STRAITS
SØUTH - NØRTH
EAST - WEST
N

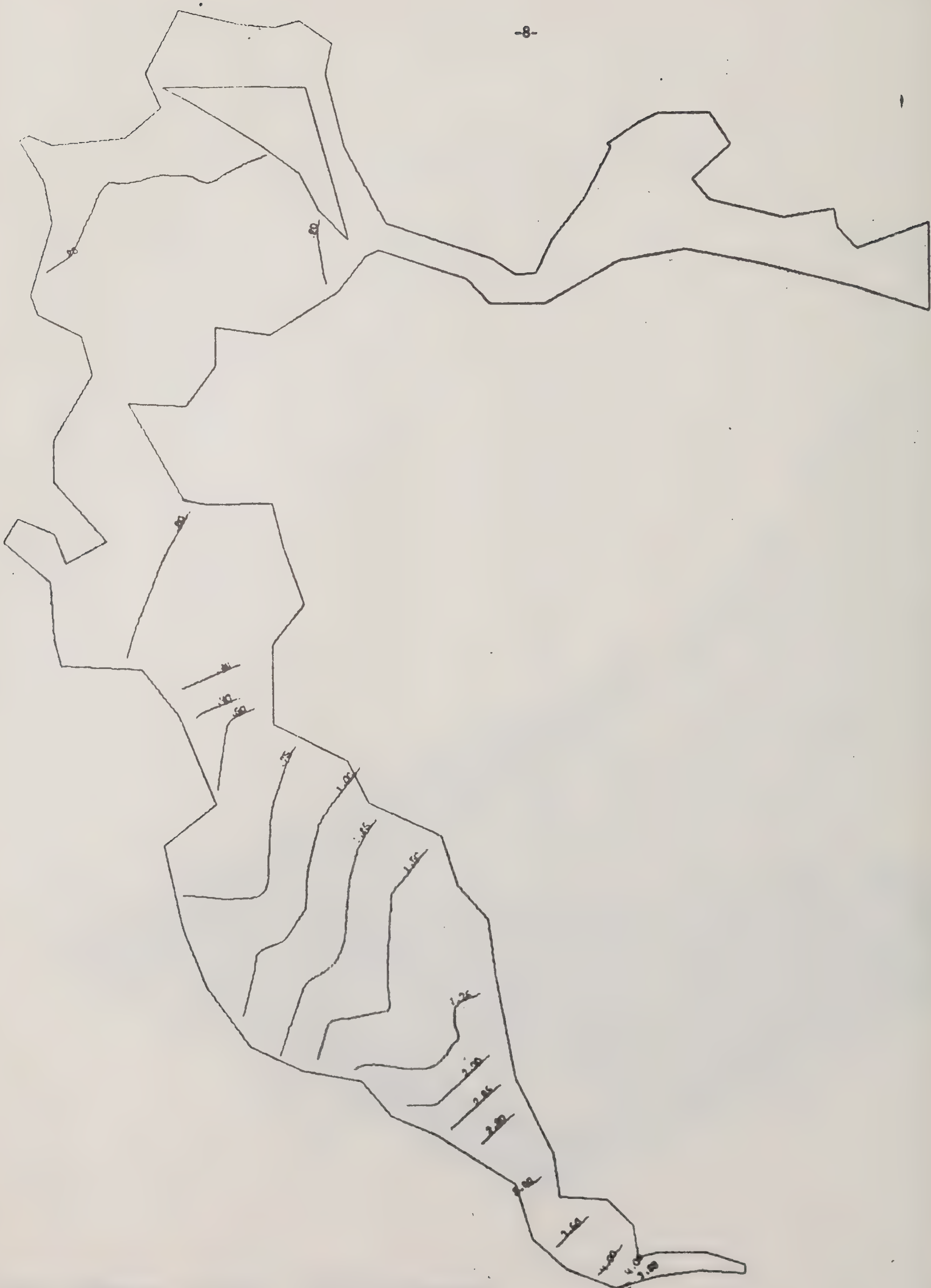


HIGH VALUE = 4.75 INTERVAL .25

TOTAL NITROGEN (MG/L)--1975 (DRY SEASON)

TØTAL NITRØGEN (MG/L)--1975 (DRY SEASØN)

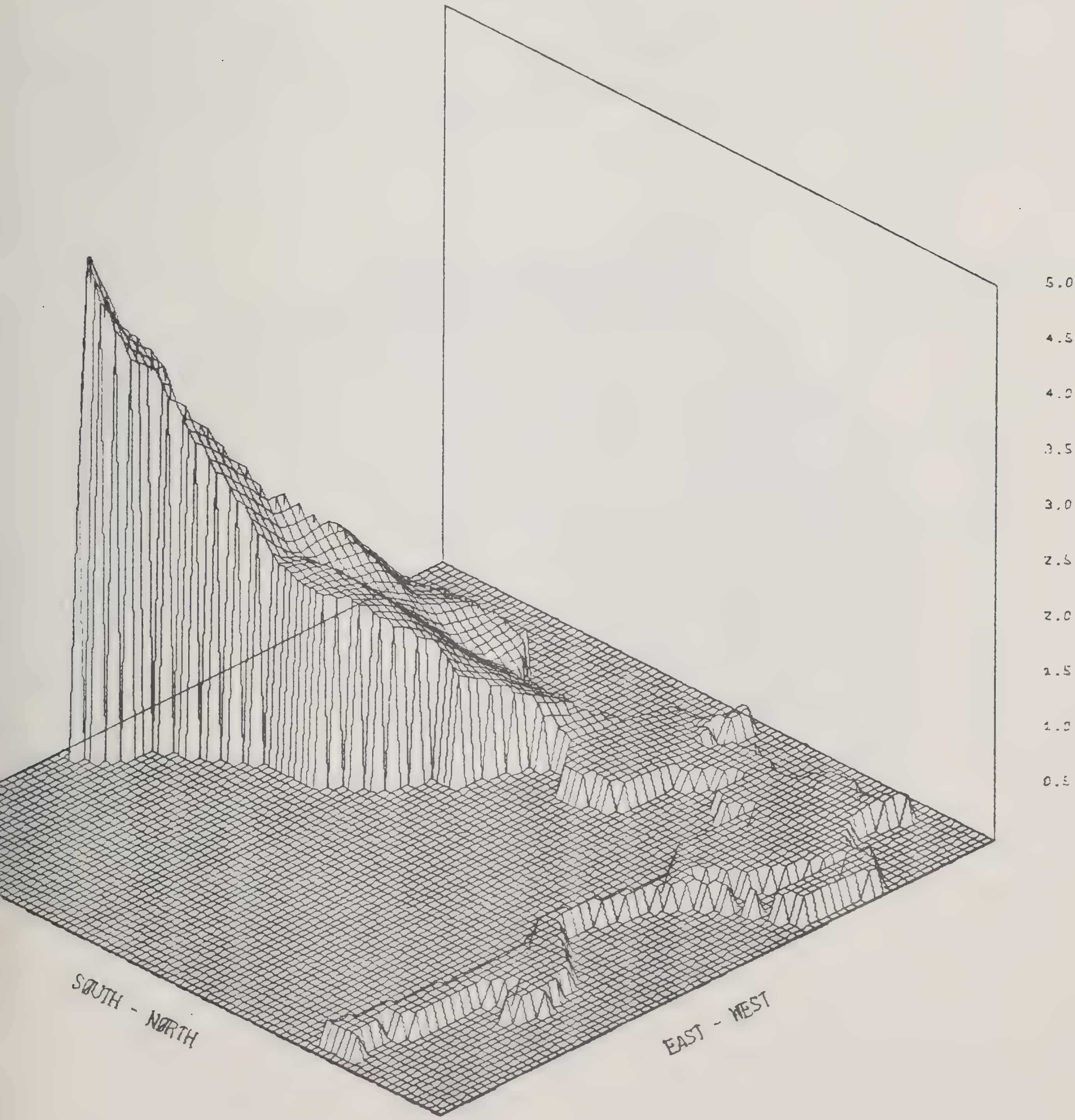


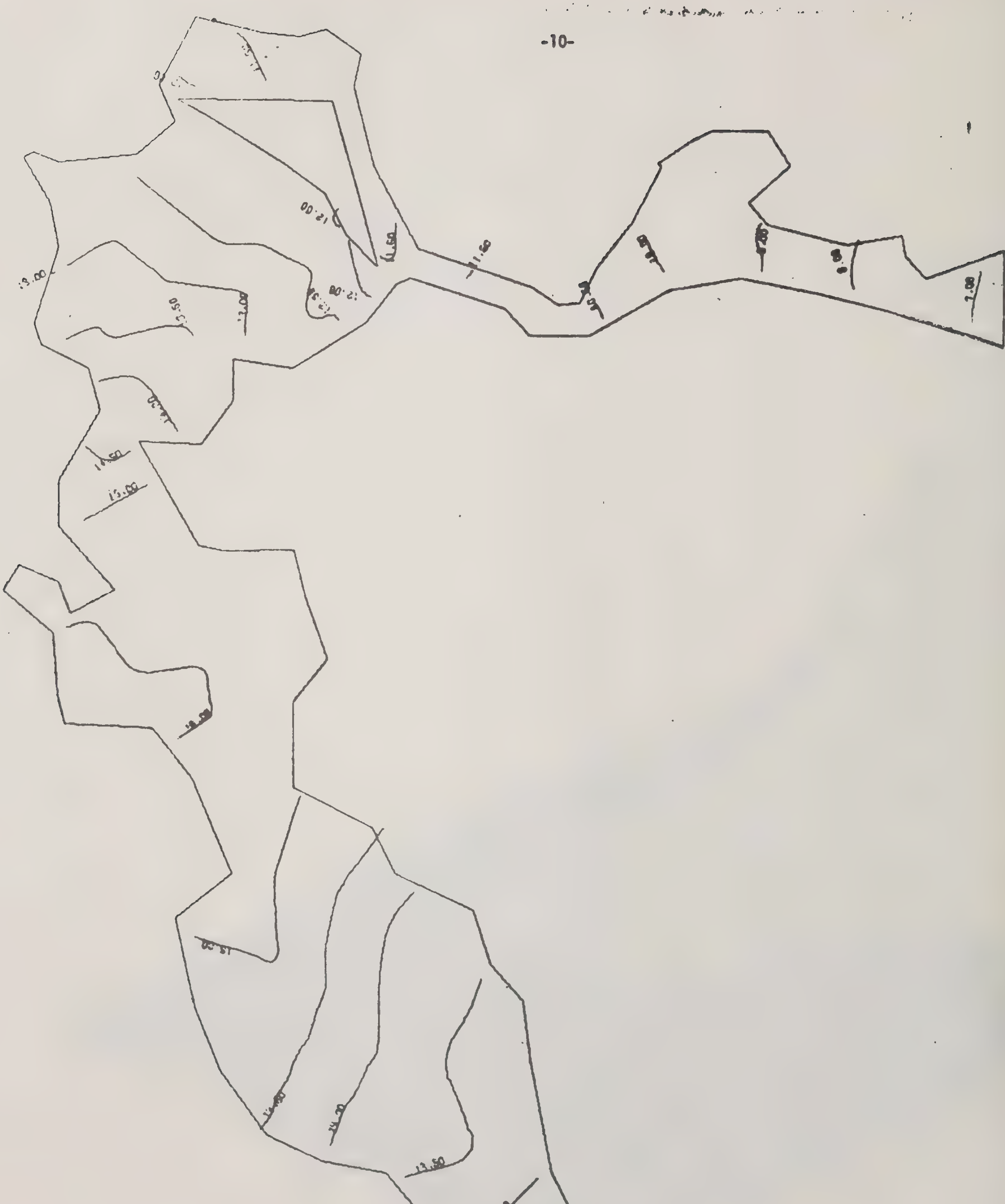


HIGH VALUE = 4.44 INTERVAL .25

TOTAL PHOSPHOROUS (MG/L)--1975 (DRY SEASON)

TØTAL PHØSPHØRØUS (MG/L)--1975 (DRY SEASØN)

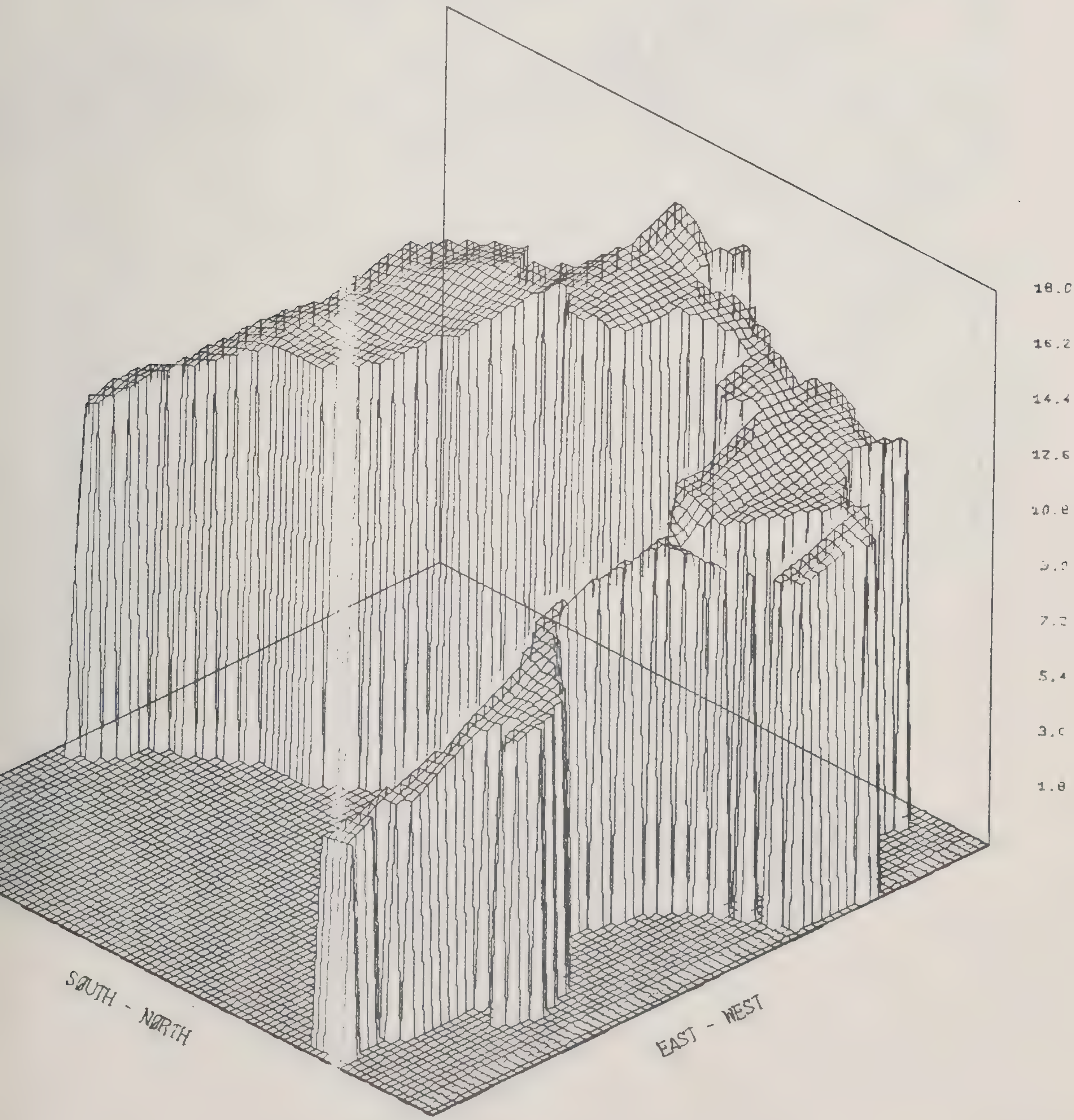




HIGH VALUE = 16.89 INTERVAL 1.00

CHLORIDE/1000 (MG/L)--1975 DRY SEASON)

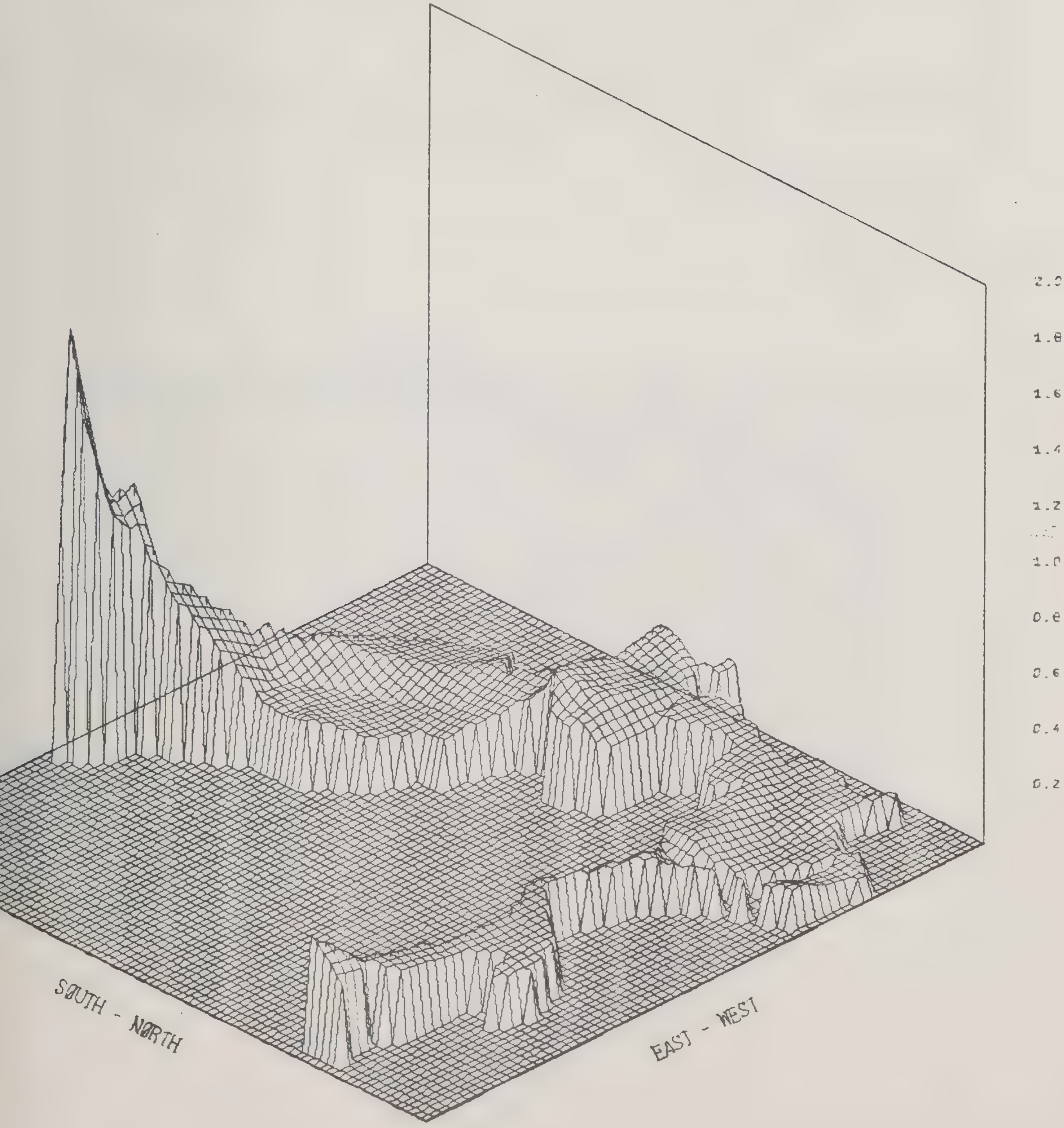
CHLØRIDE/1000 (M?/L)--1975 DRY SEASØN)

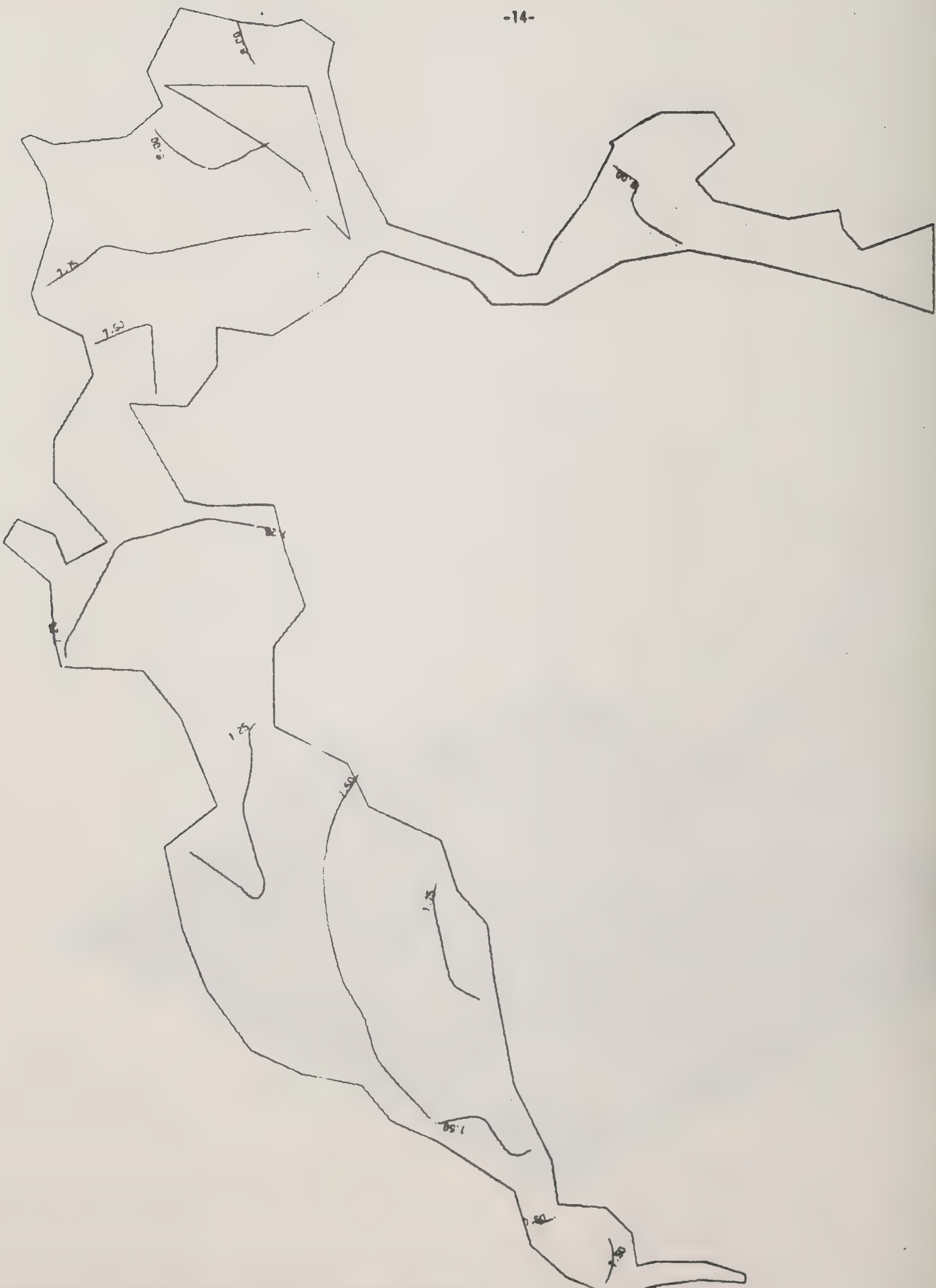


HIGH VALUE = 1.52 INTERVAL .05

BOD5 (MG/L)--1975 (DRY SEASON)

BØD5 (MG/L)--1975 (DRY SEASØN)

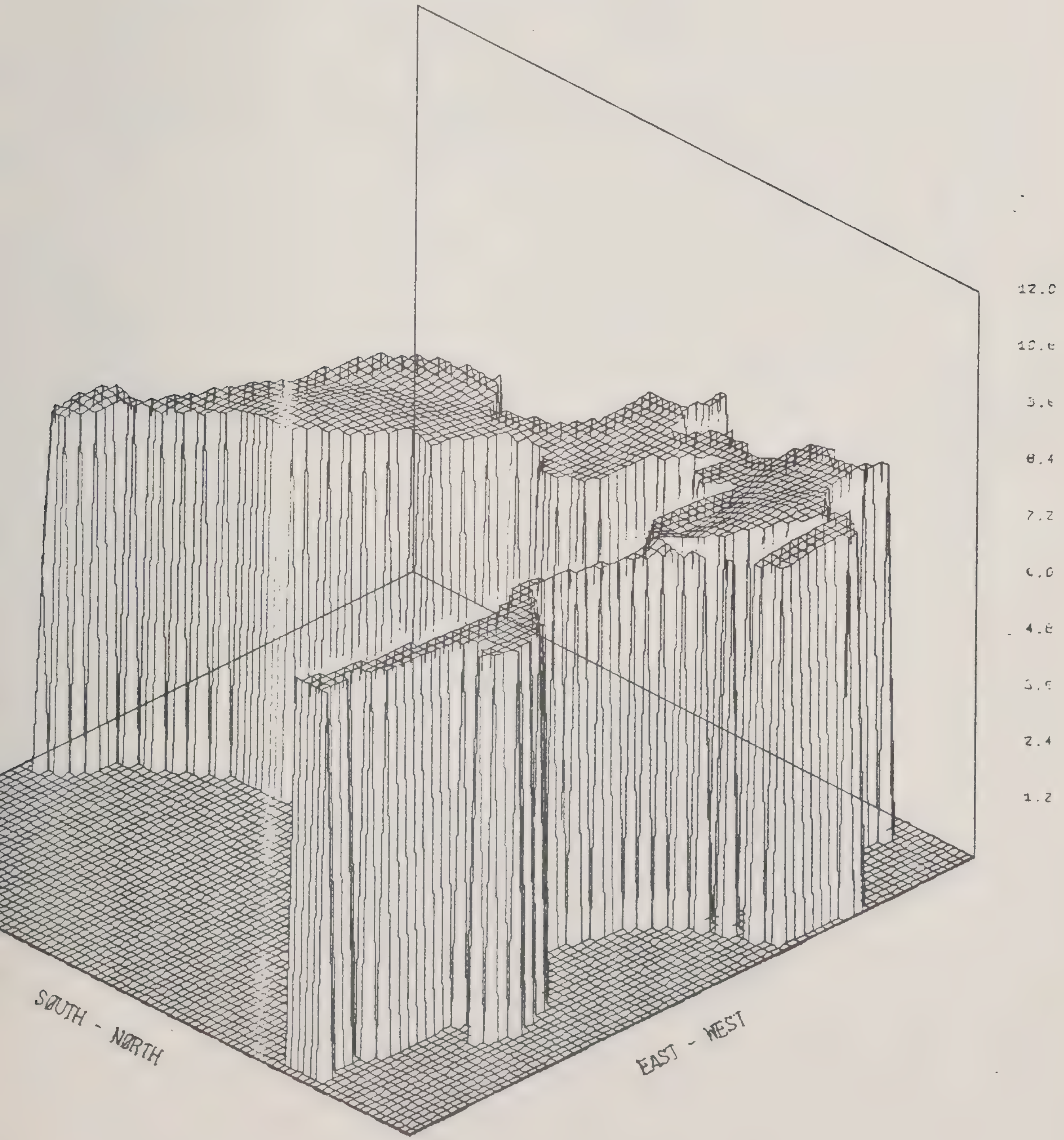


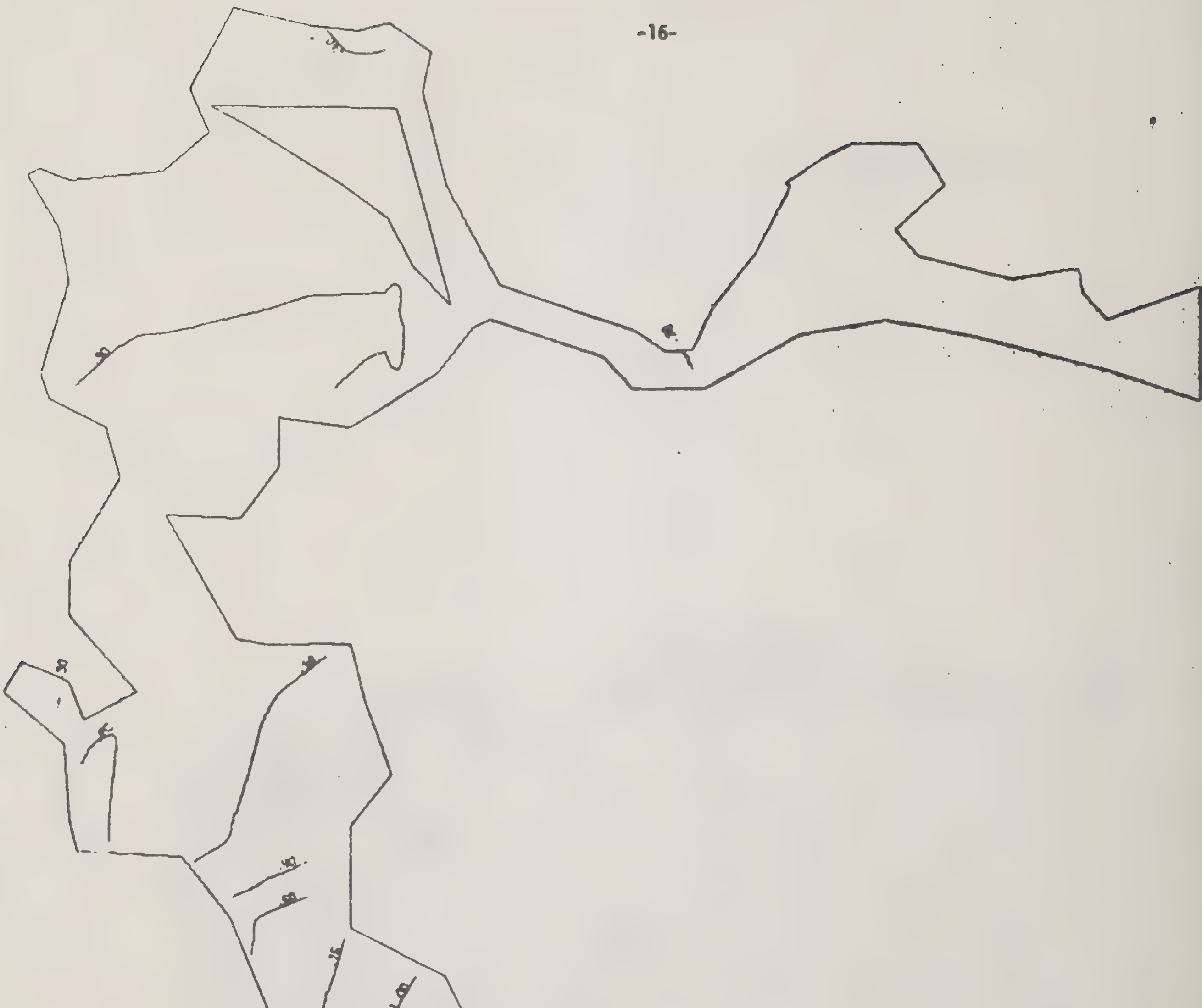


HIGH VALUE = 8.15 INTERVAL .25

DISSOLVED OXYGEN (MG/L)---1975 (DRY SEASON)

DISSØLVED ØXYGEN (MG/L)--1975 (DRY SEASØN)

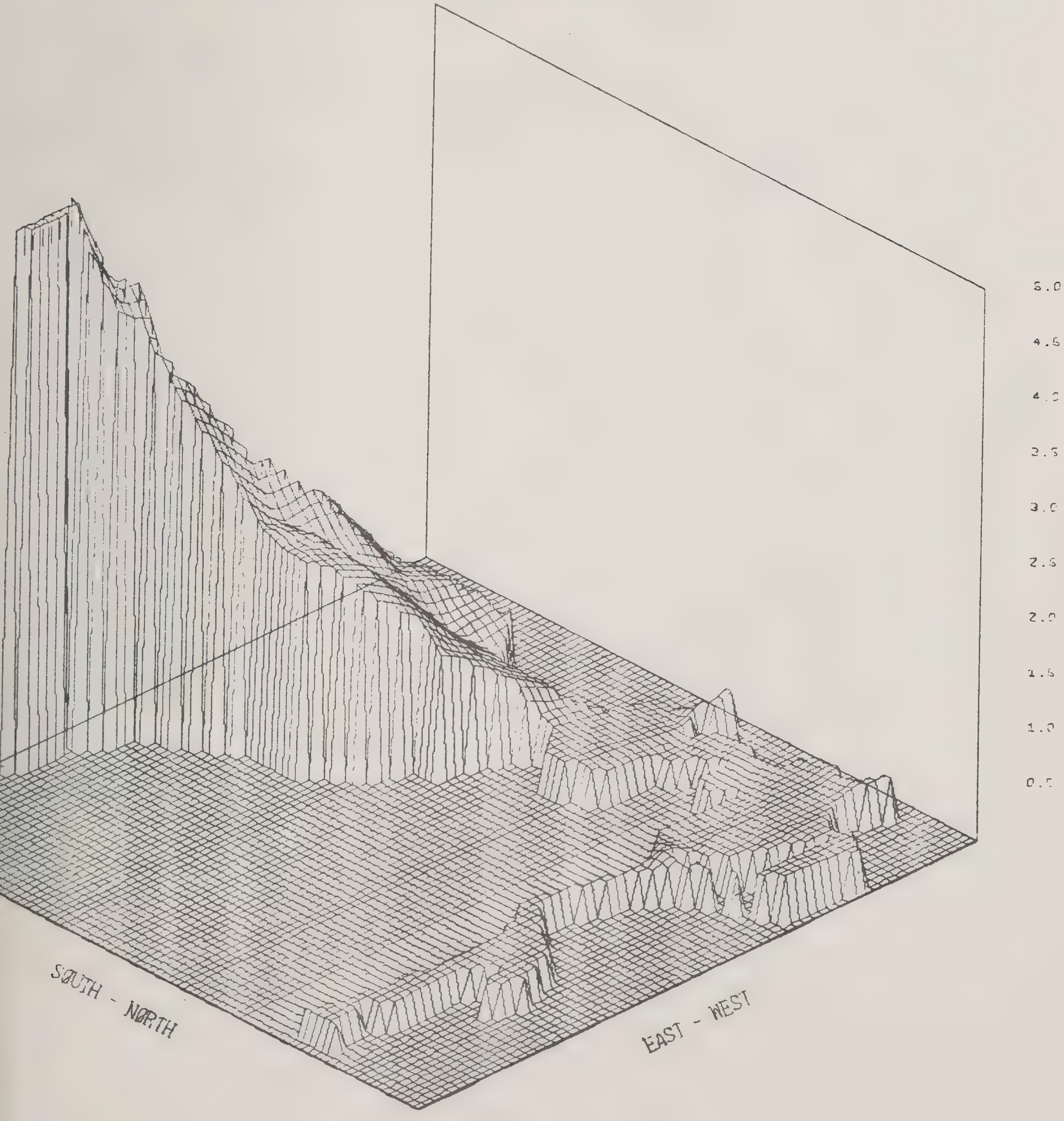




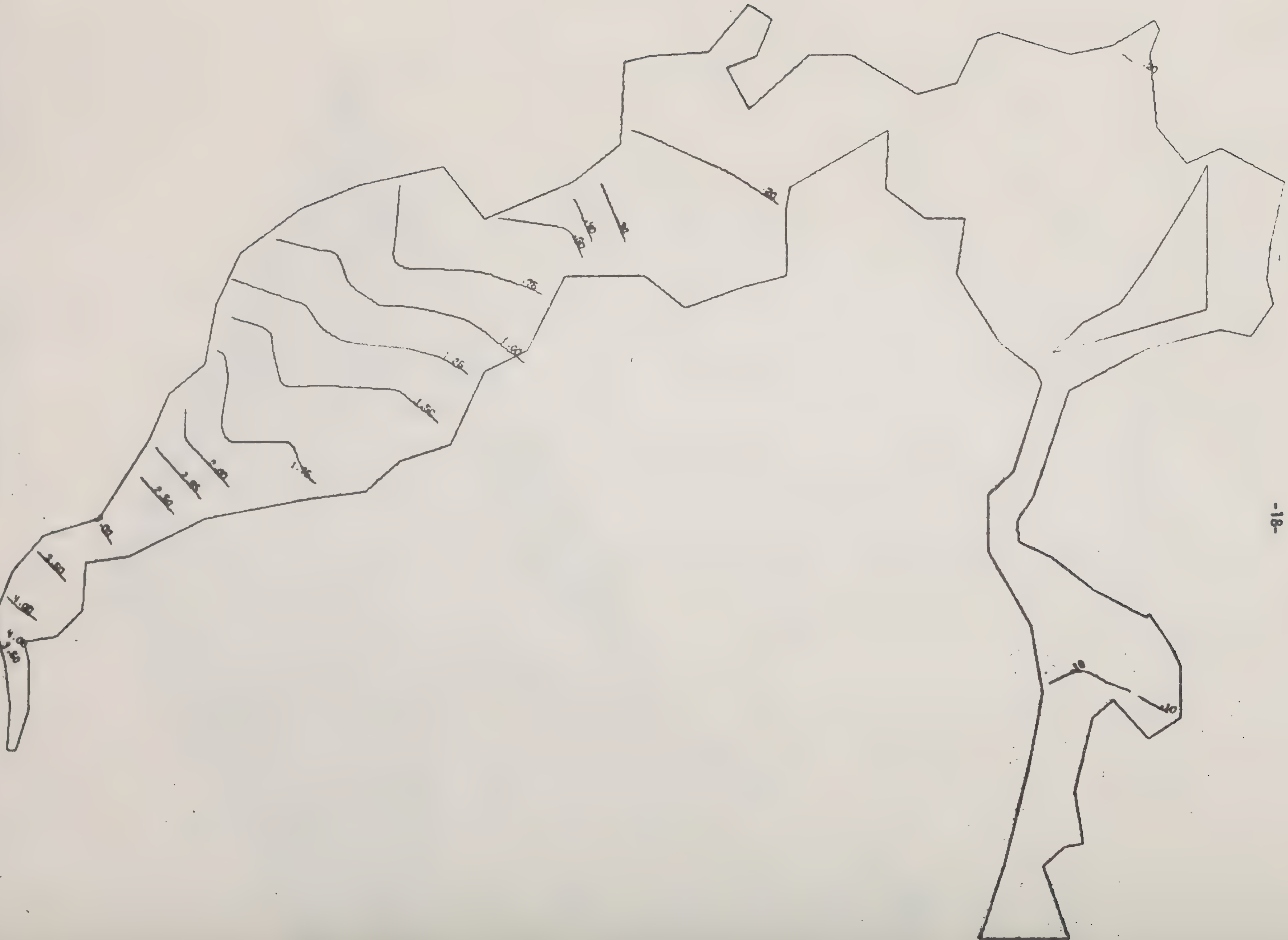
HIGH VALUE = 4.84 INTERVAL .25

TOTAL NITROGEN (MG/L)--1975(BEFORE STORM)

TØTAL NITRØGEN (MG/L)--1975(BEFØRE STØRM)

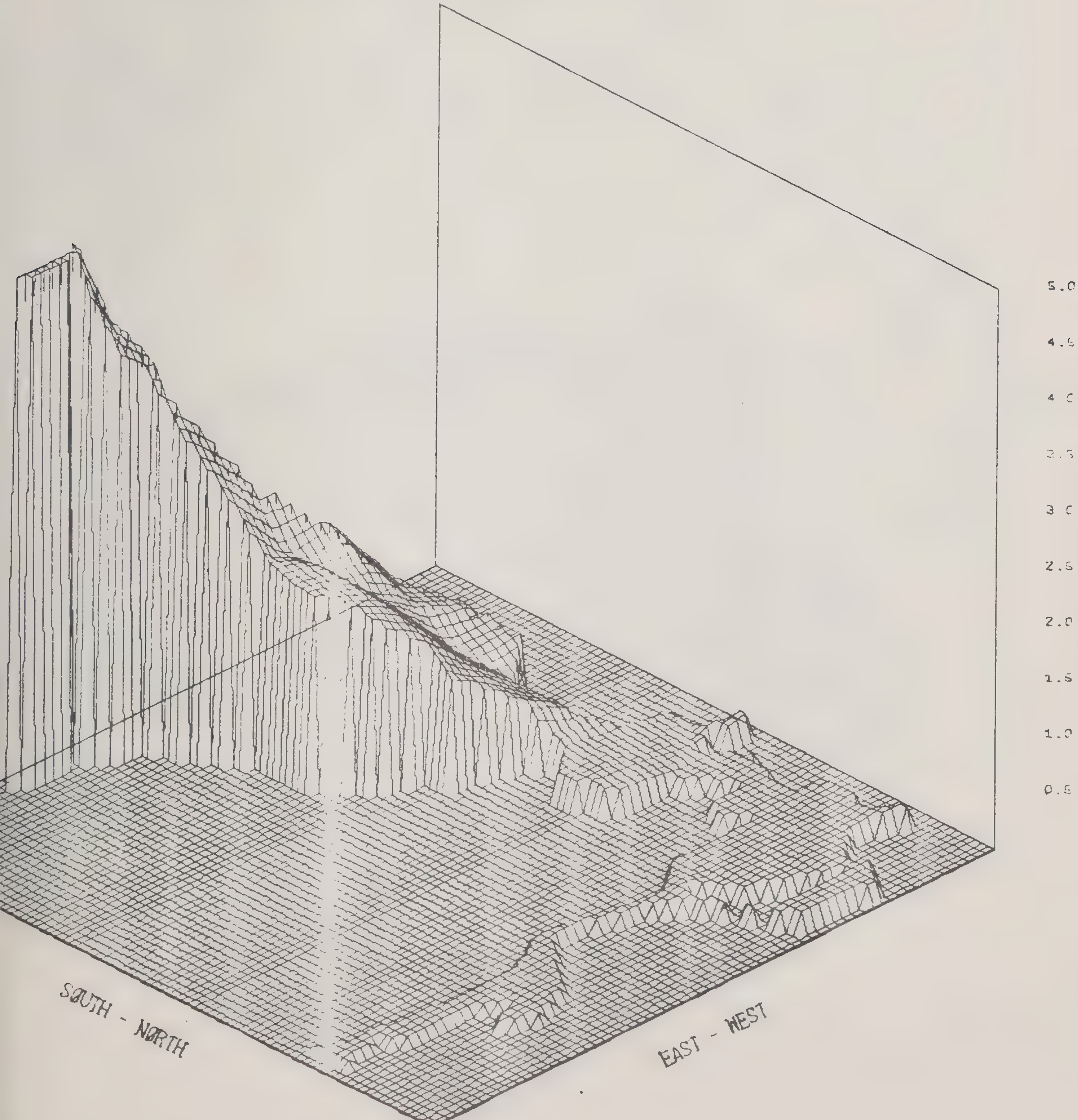


TOTAL PHOSPHORUS (MG/L) 1975(BEFORE STORM)



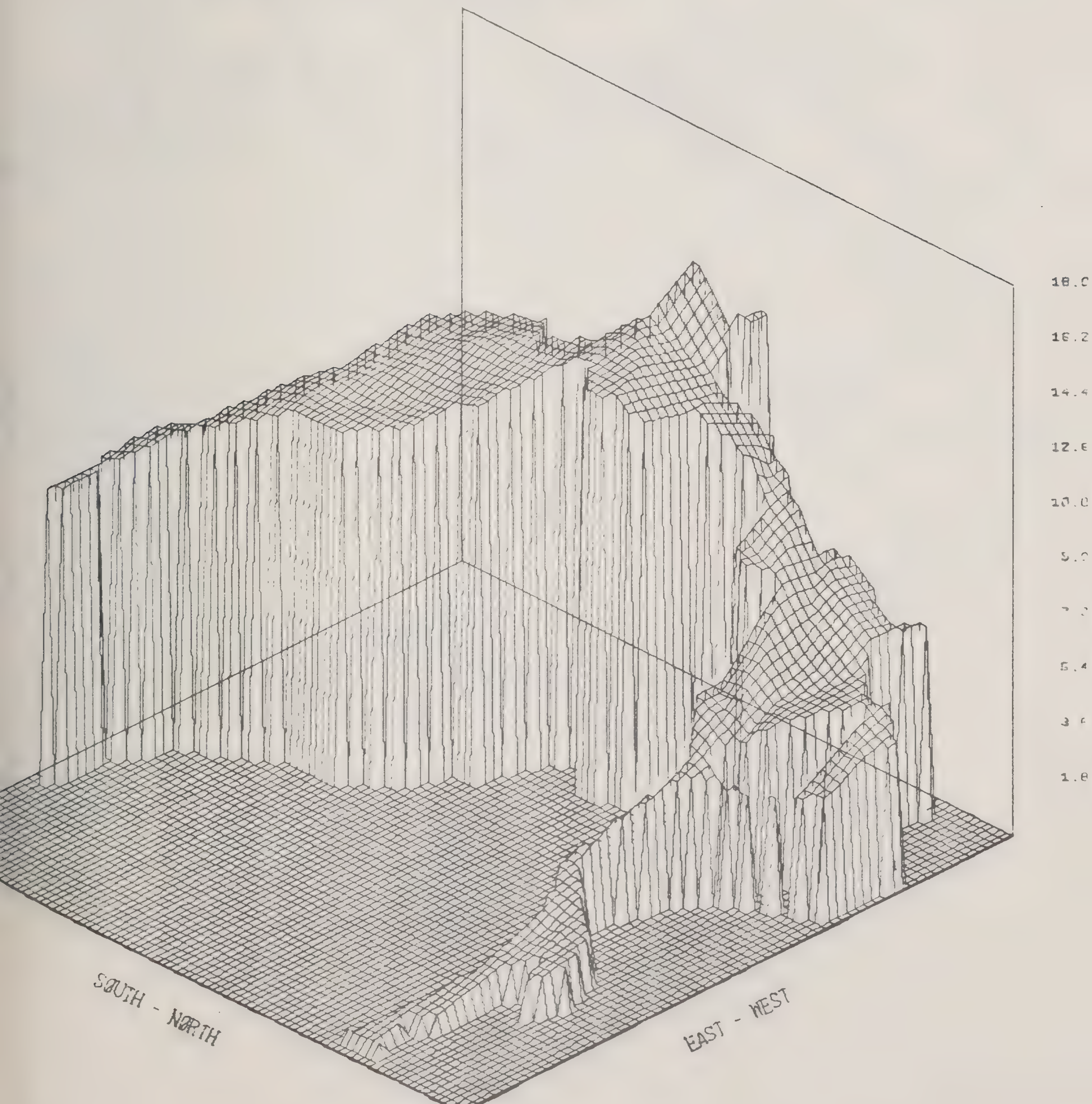
HIGH VALUE = 4.49 INTERVAL .25

TØTAL PHØSPHØRØU (MG/L)--1975(BEFØRE STØRM)




HIGH VALUE = 14.94
INTERVAL 1.00

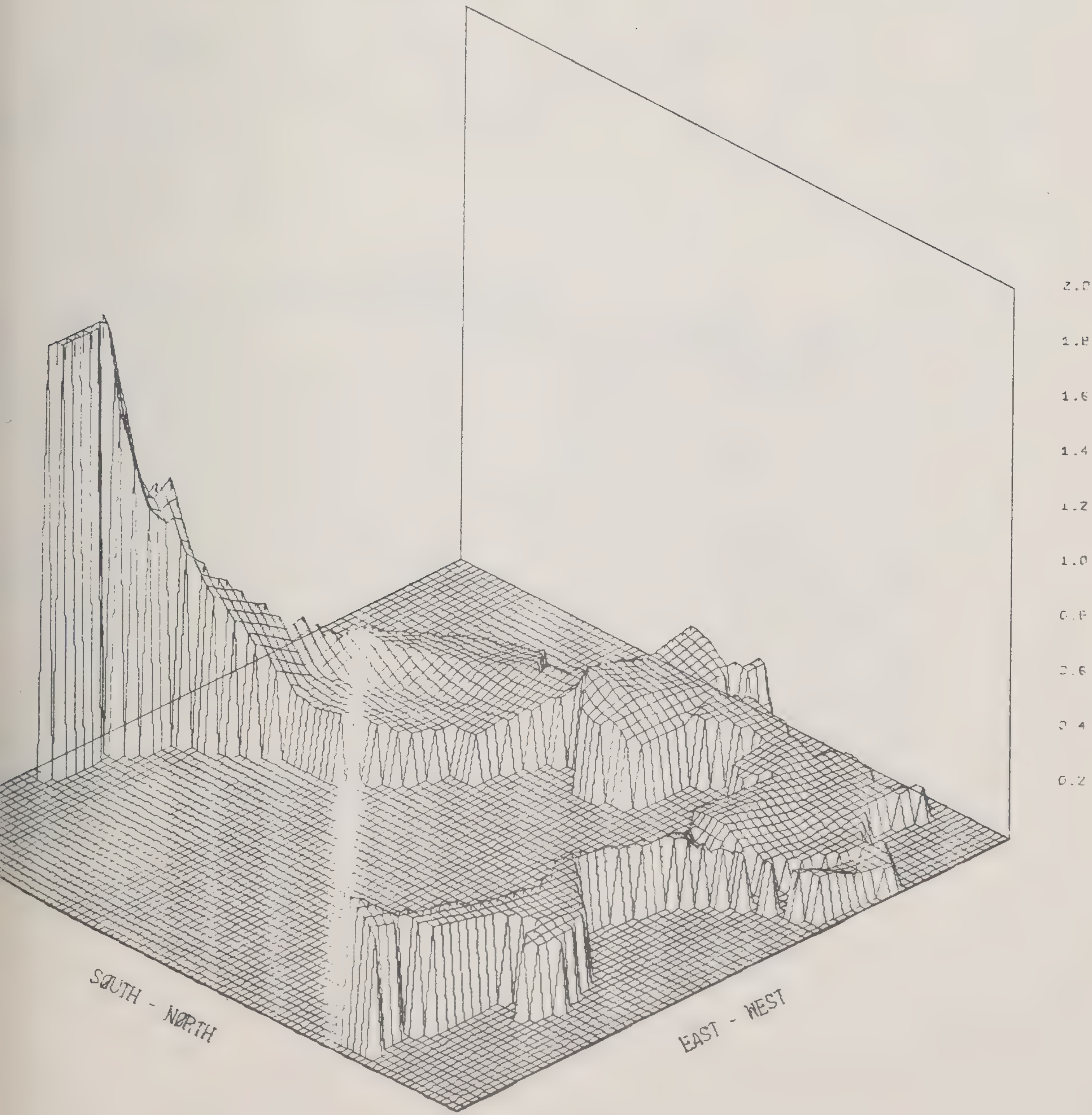
CHLØRIDE/1000 (MG/L)--1975(BEFØRE STØRM)

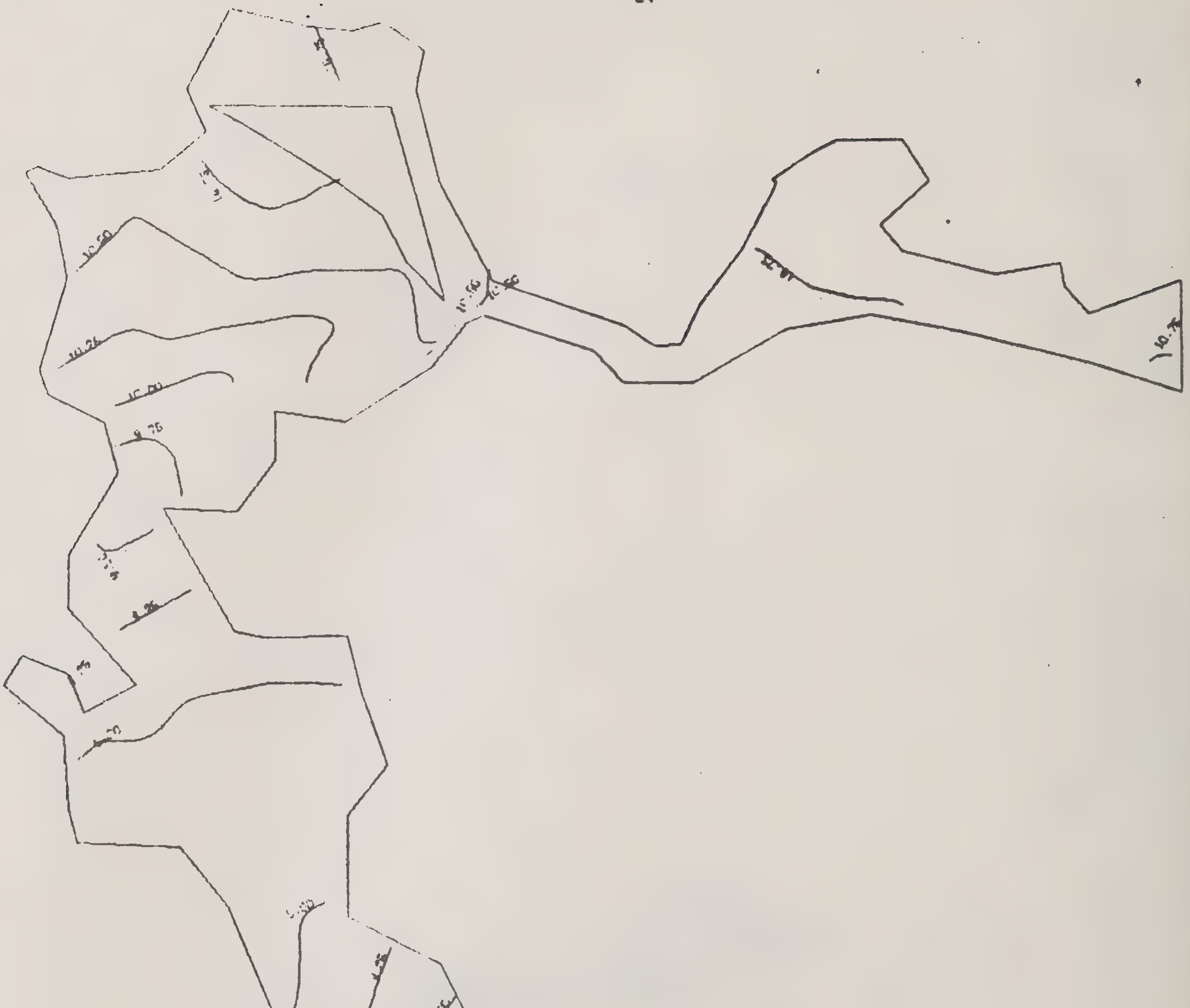


HIGH VALUE = 1.53 INTERVAL .05

BODS (MG/L)--1975 (BEFORE STORM)

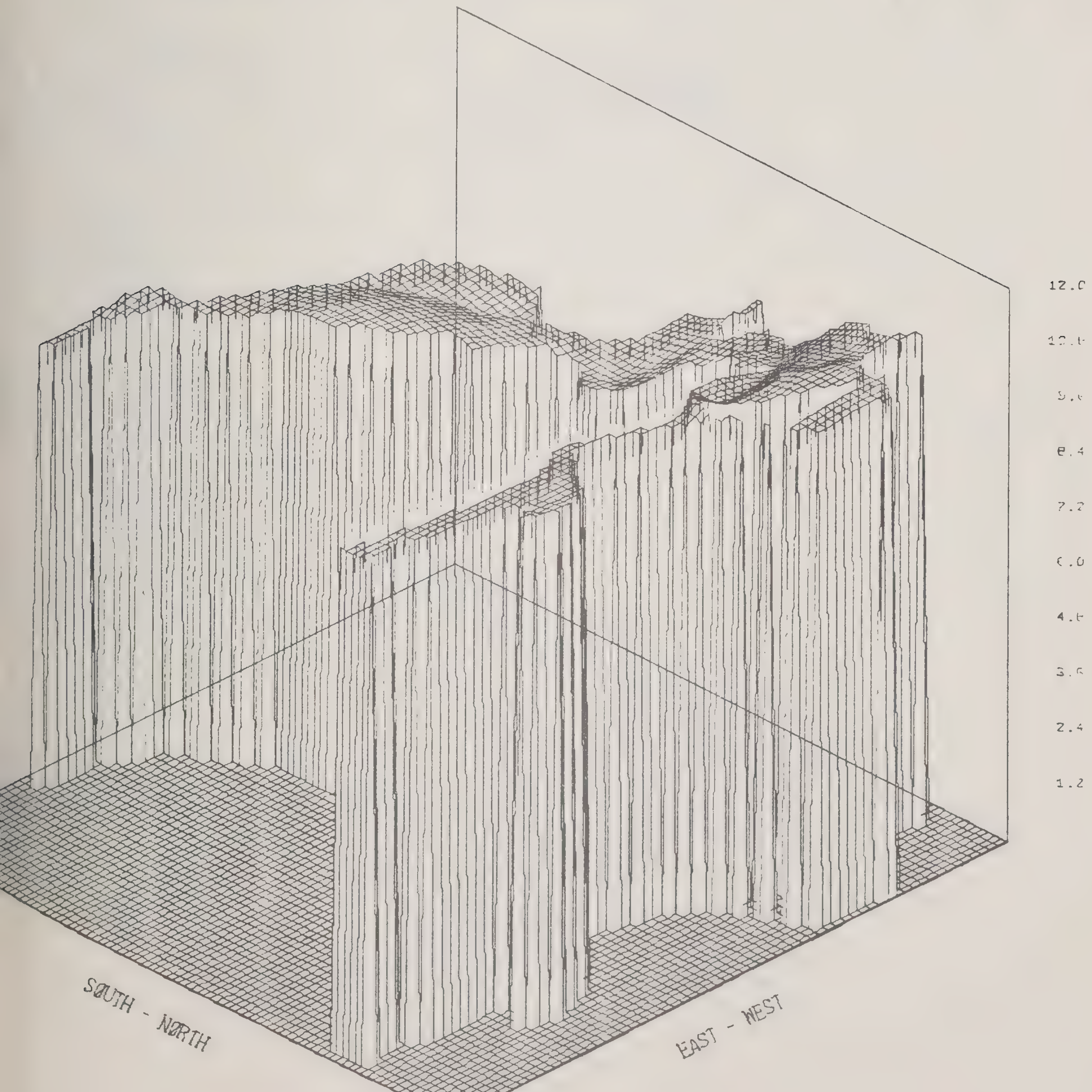
BØD5 (MG/L)--1975 (BEFØRE STØRM)

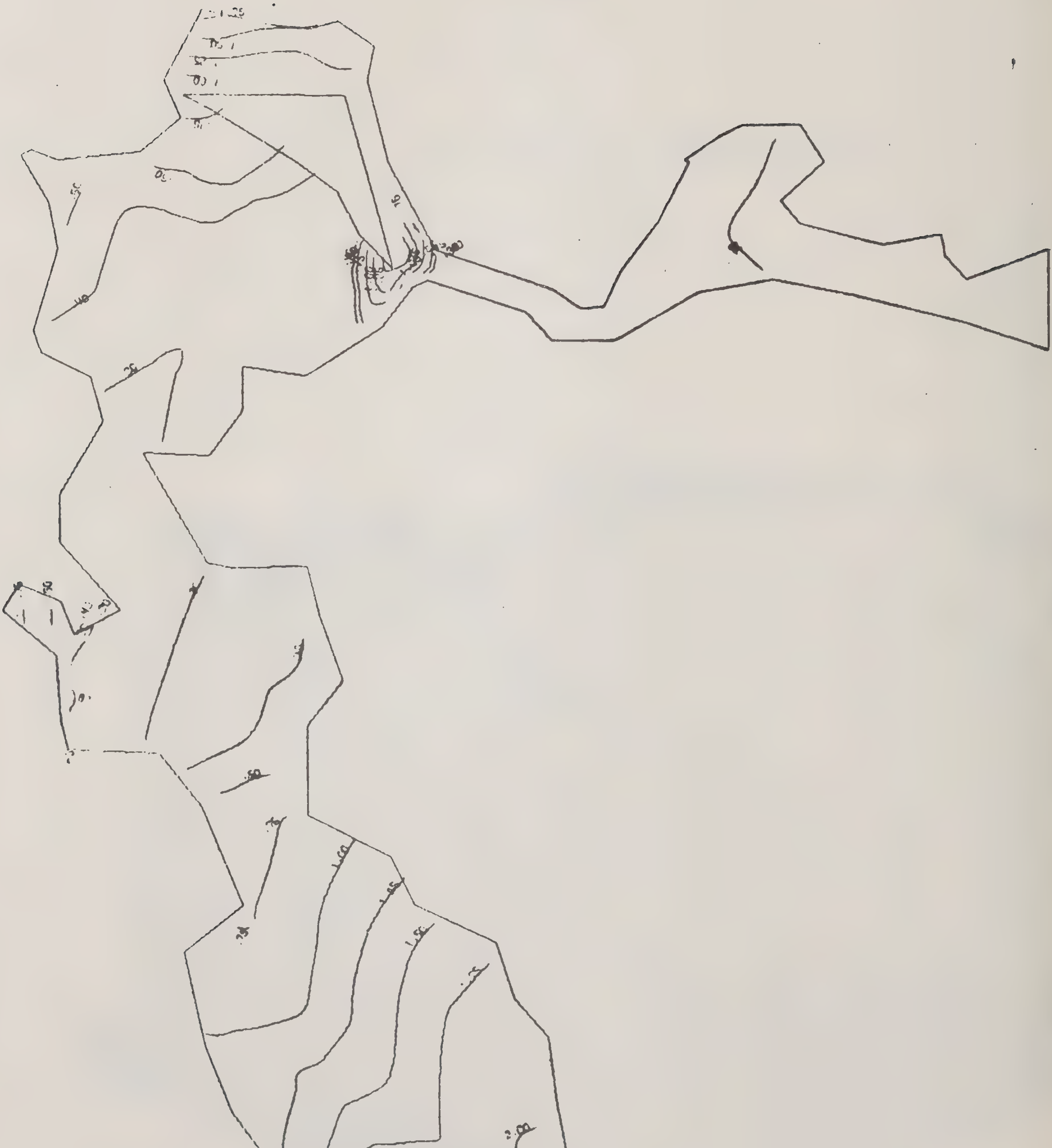




DISSOLVED OXYGEN (MG/L)--1975(BEFORE STORM)

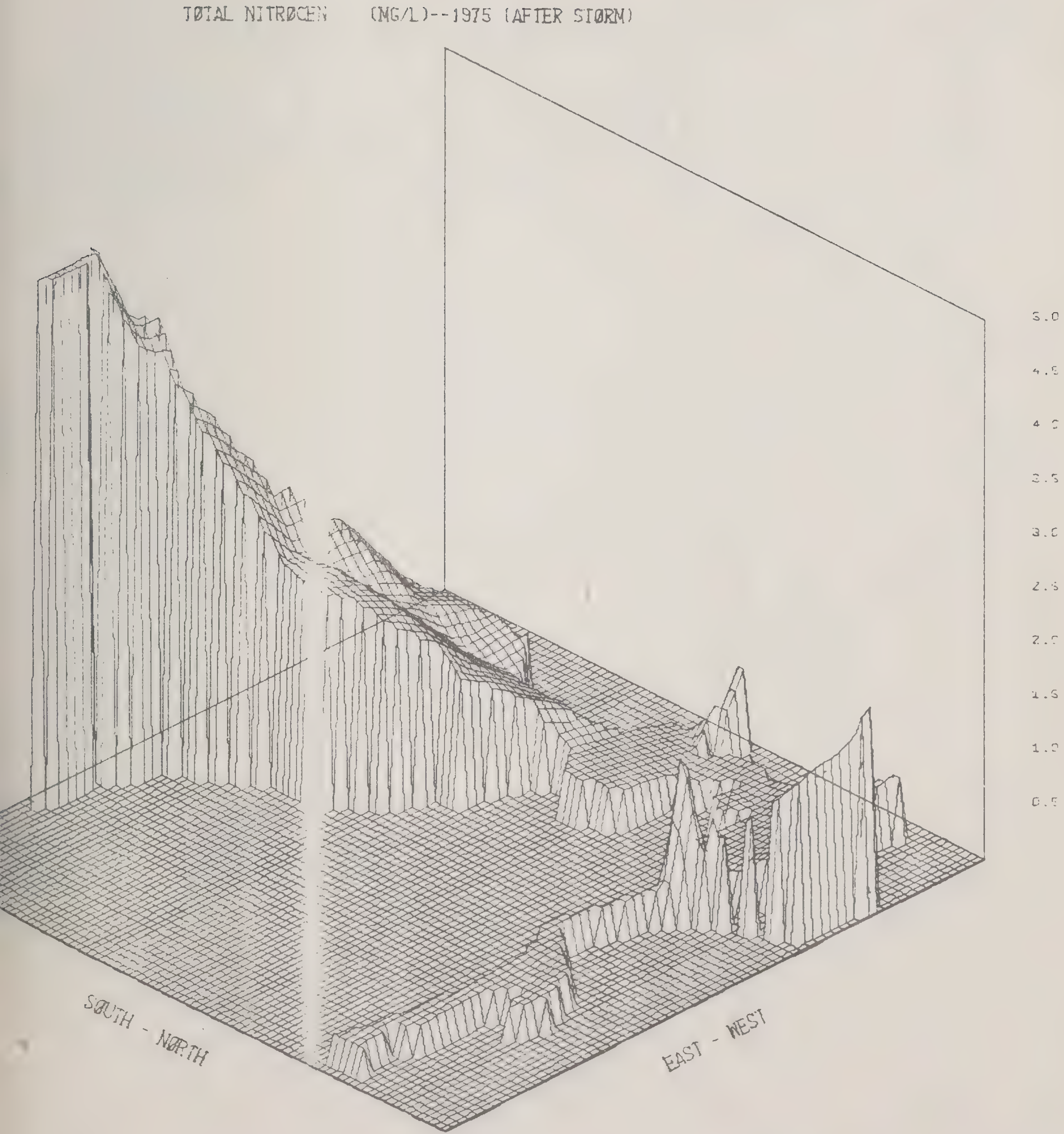
DISSØLVED ØXYGEN (MG/L)--1975(BEFØRE STØRM)





HIGH VALUE = 4.81 INTERVAL .25

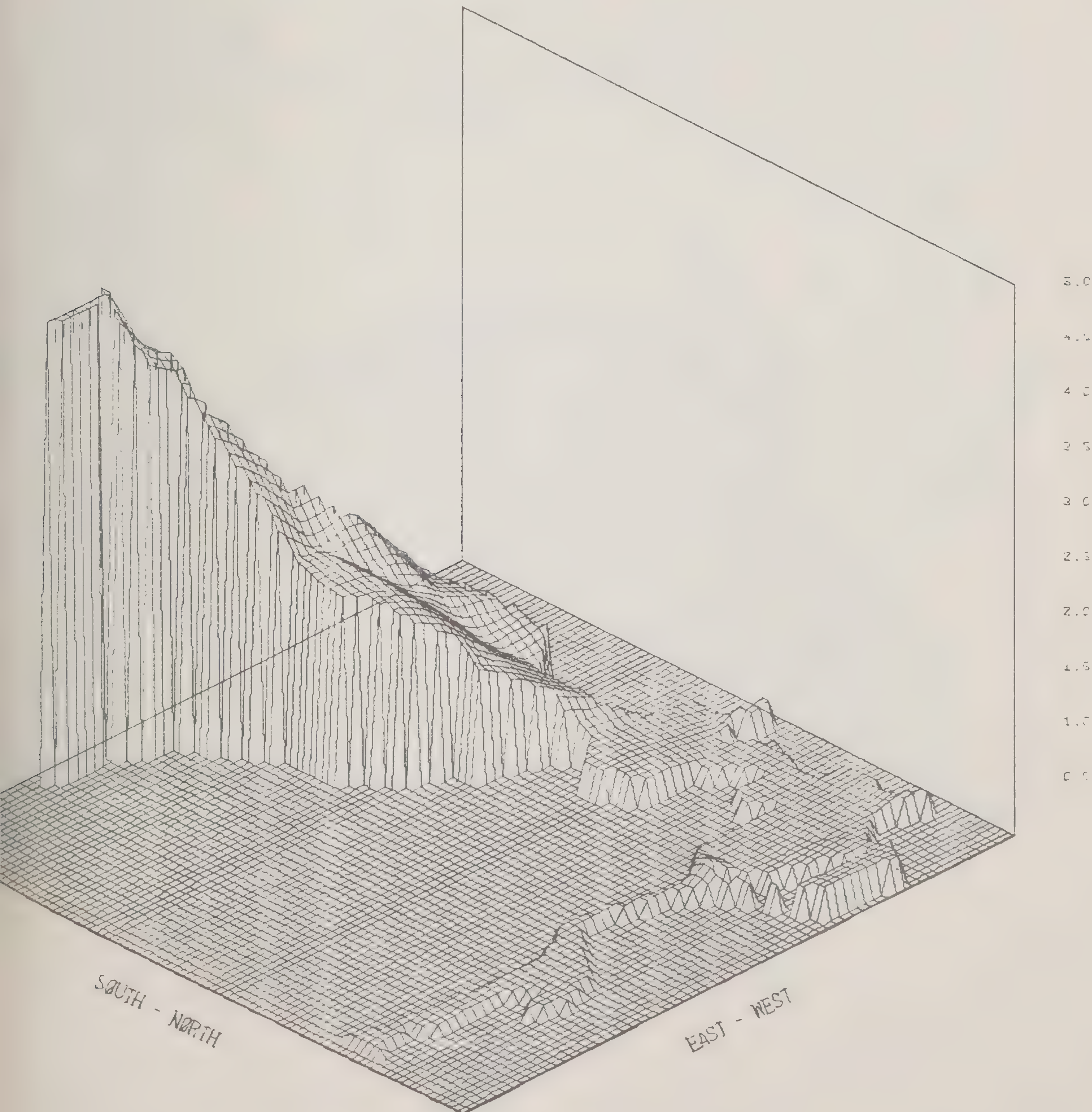
TOTAL NITROGEN (MG/L)--1975 (AFTER STORM)

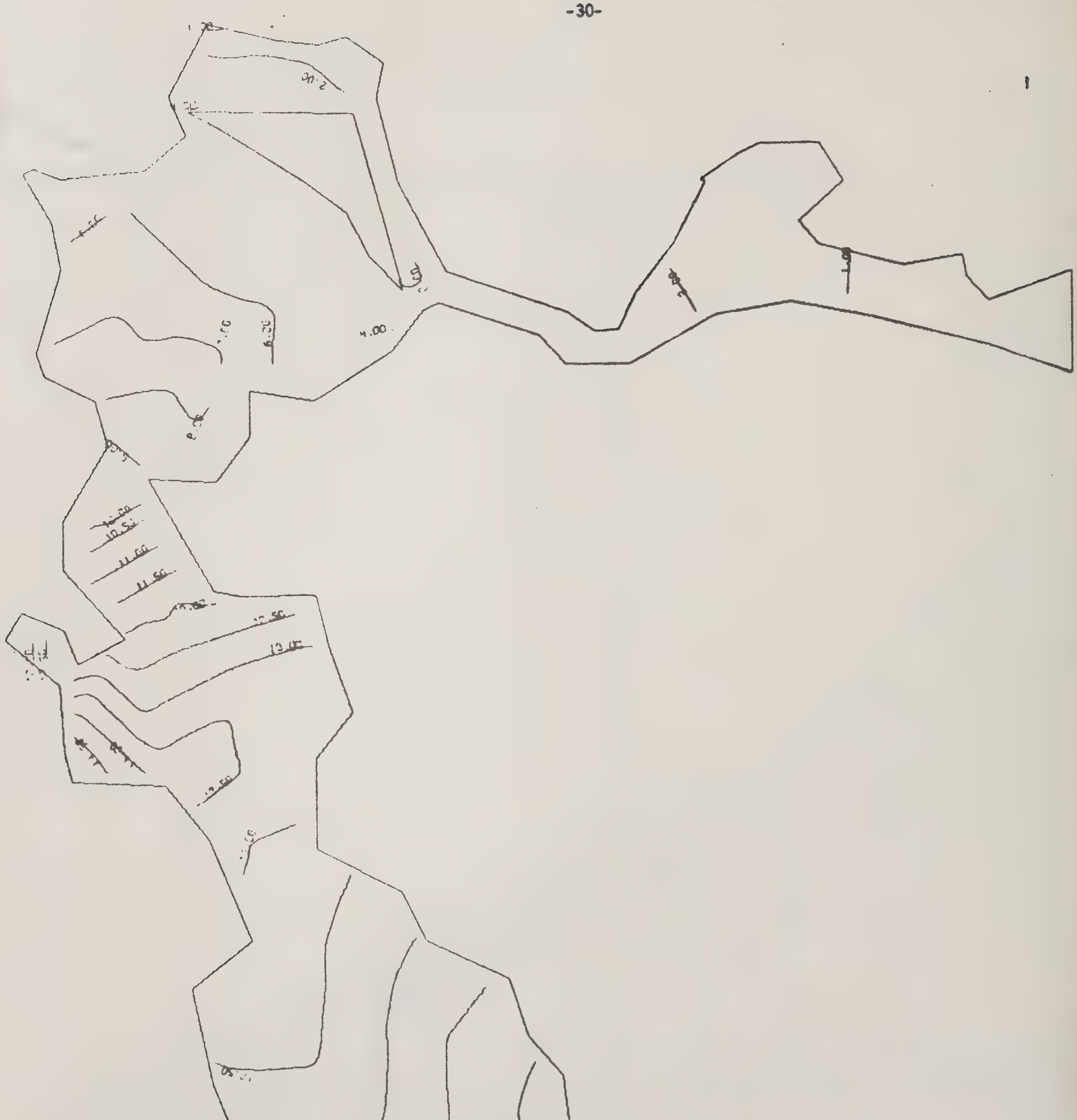

TØTAL NITRØGEN (MG/L)--1975 (AFTER STØRM)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
SØUTH - NØRTH
EAST - WEST

HIGH VALUE =   INTERVAL .25

TOTAL PHOSPHOROUS (MG/L)--1975 (AFTER STORM)

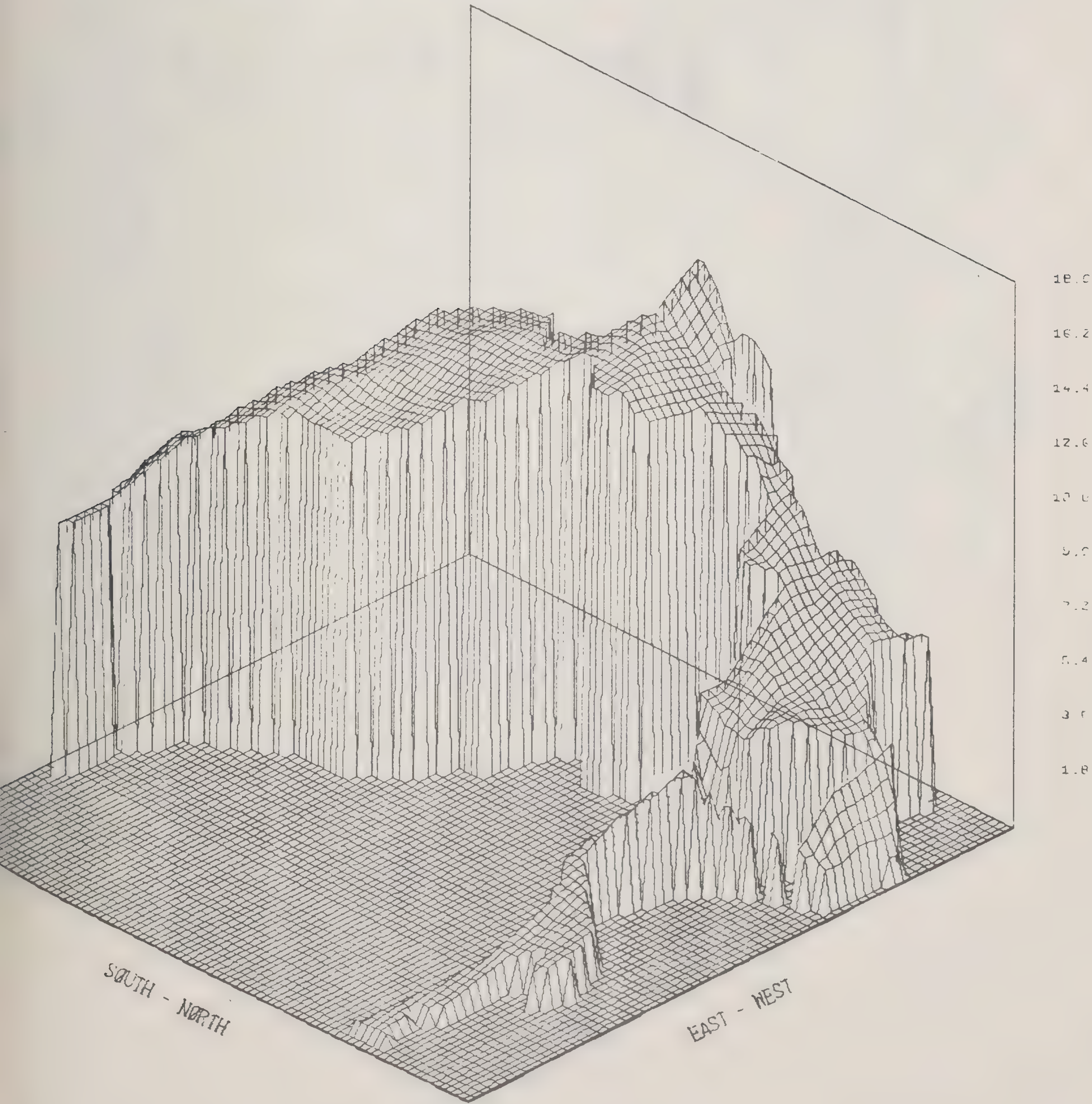
TØTAL PHØSPHØRØUS (MG/L)--1975 (AFTER STØRM)

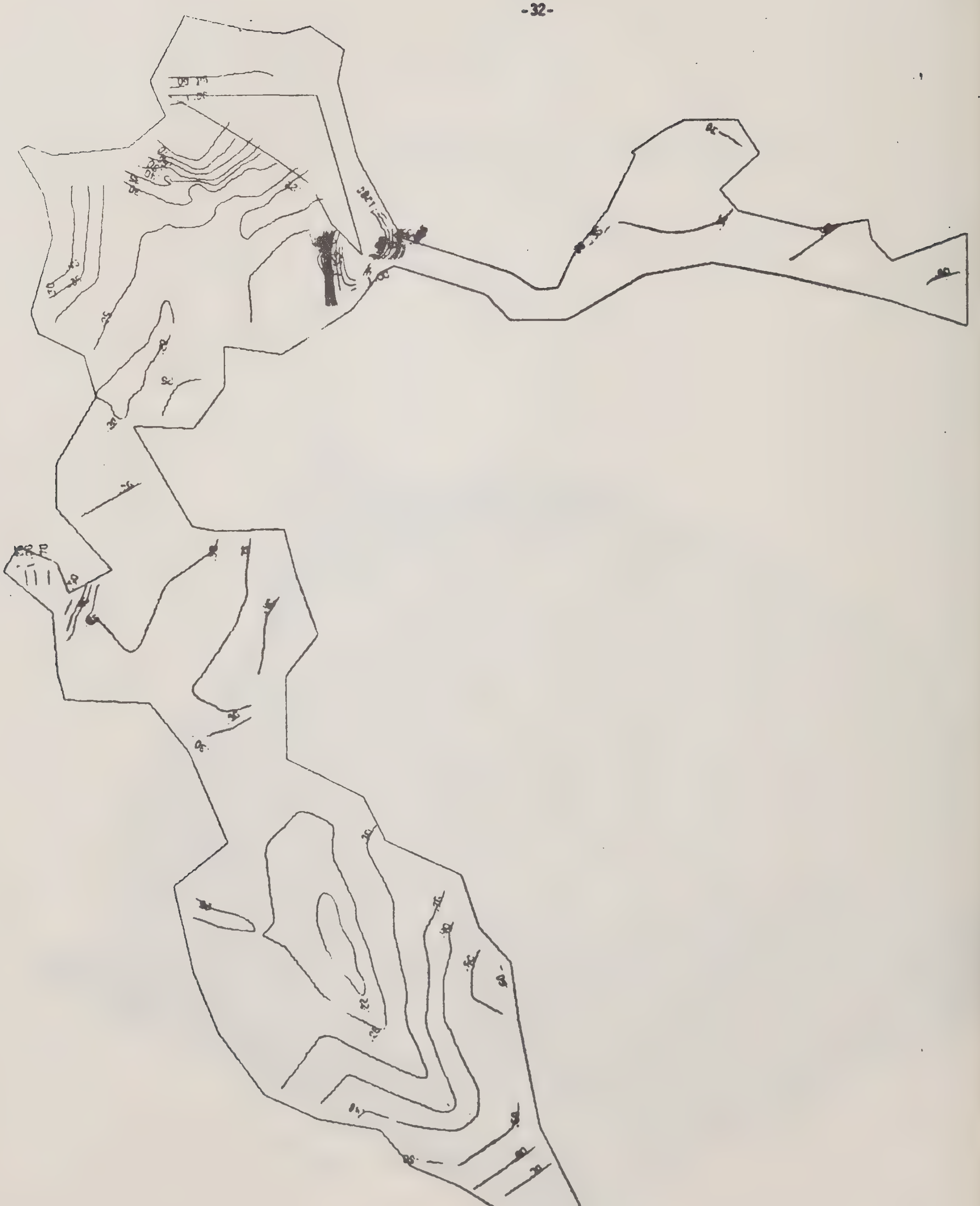




CHLORIDE/1000 (MG/L)--1975 (AFTER STORM)

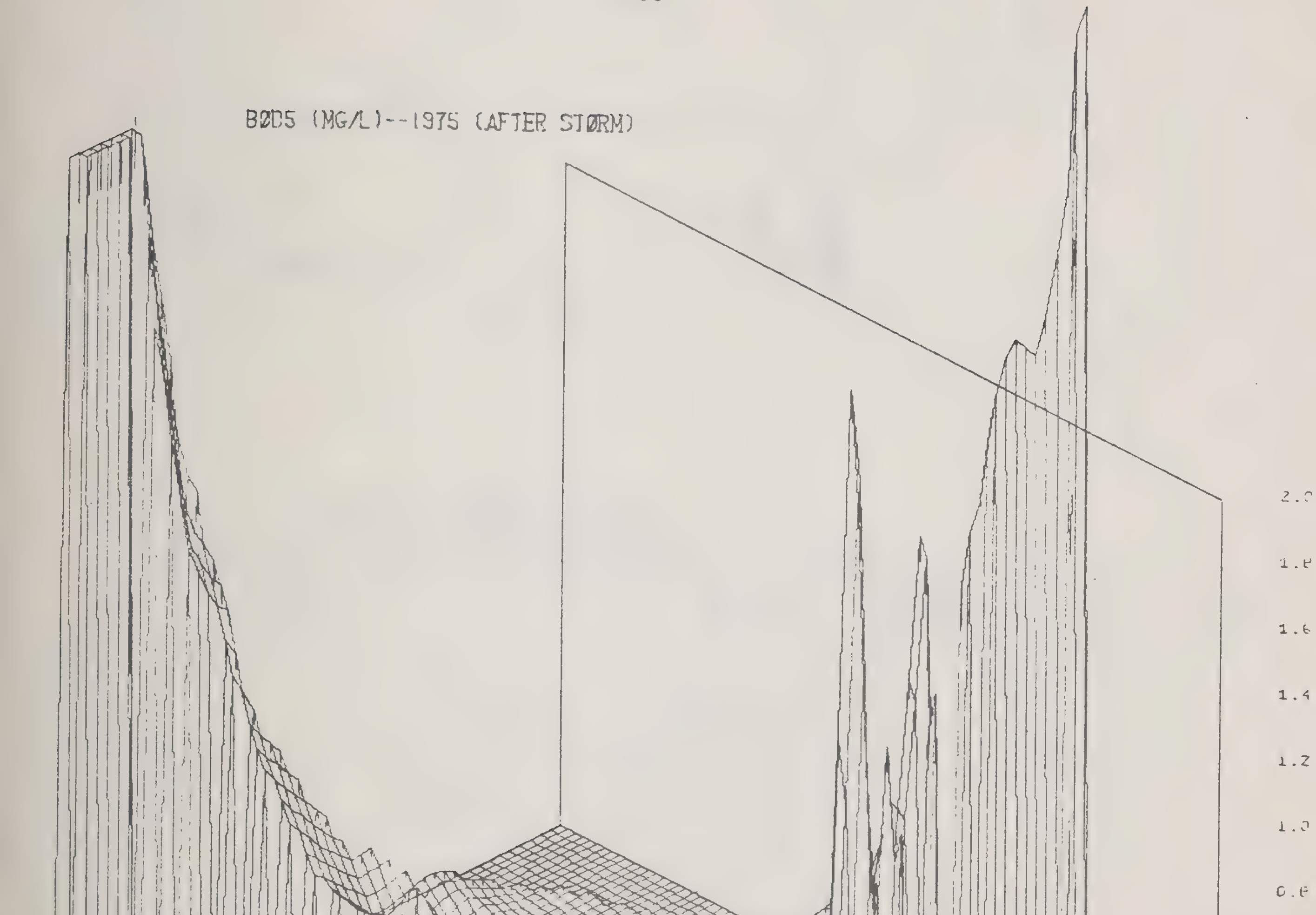
CHLØRIDE/1000 (MG/L)--1975 (AFTER STØRM)

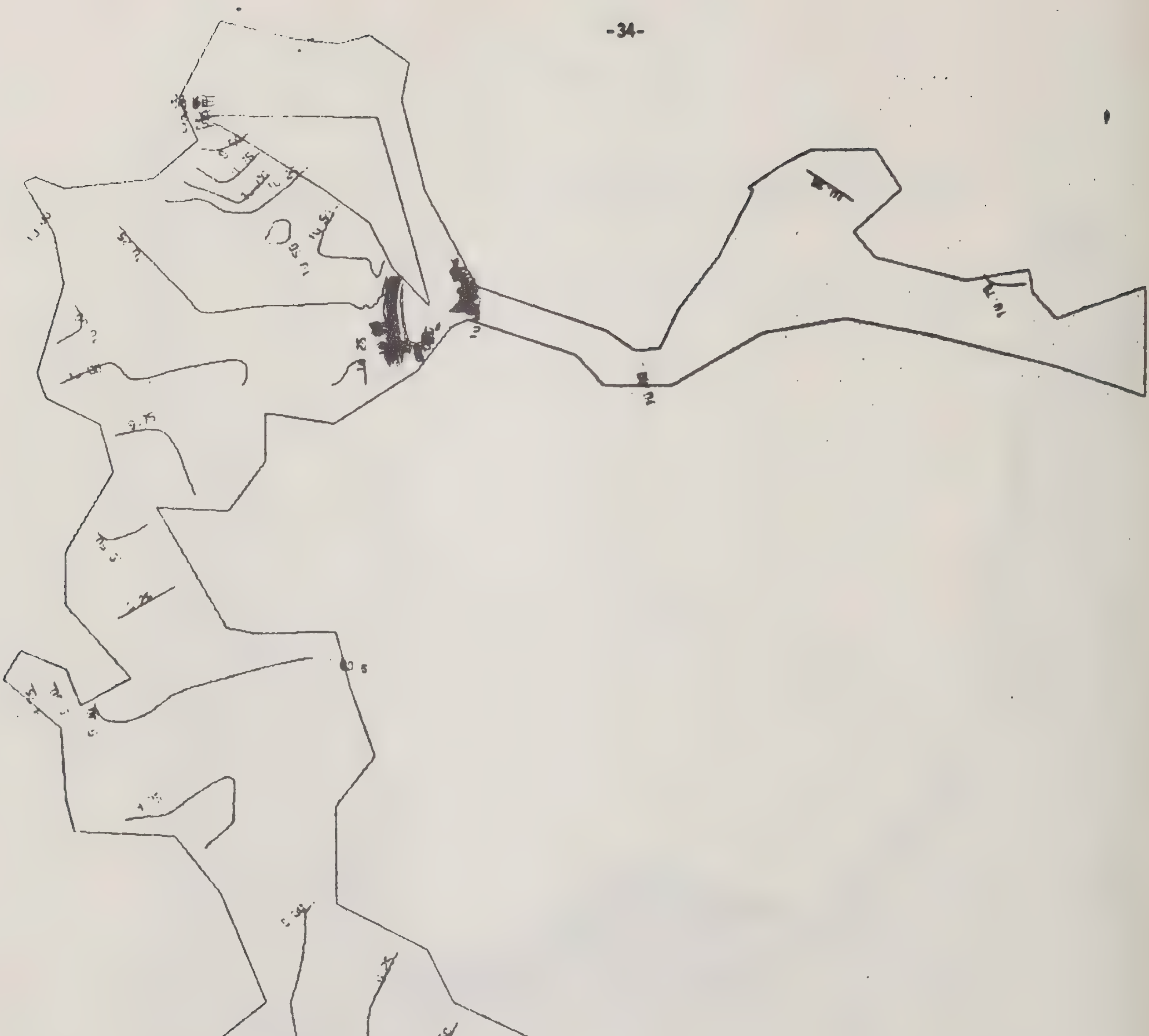




HIGH VALUE = 3.80 INTERVAL .05

BOD5 (MG/L)--1975 (AFTER STORM)

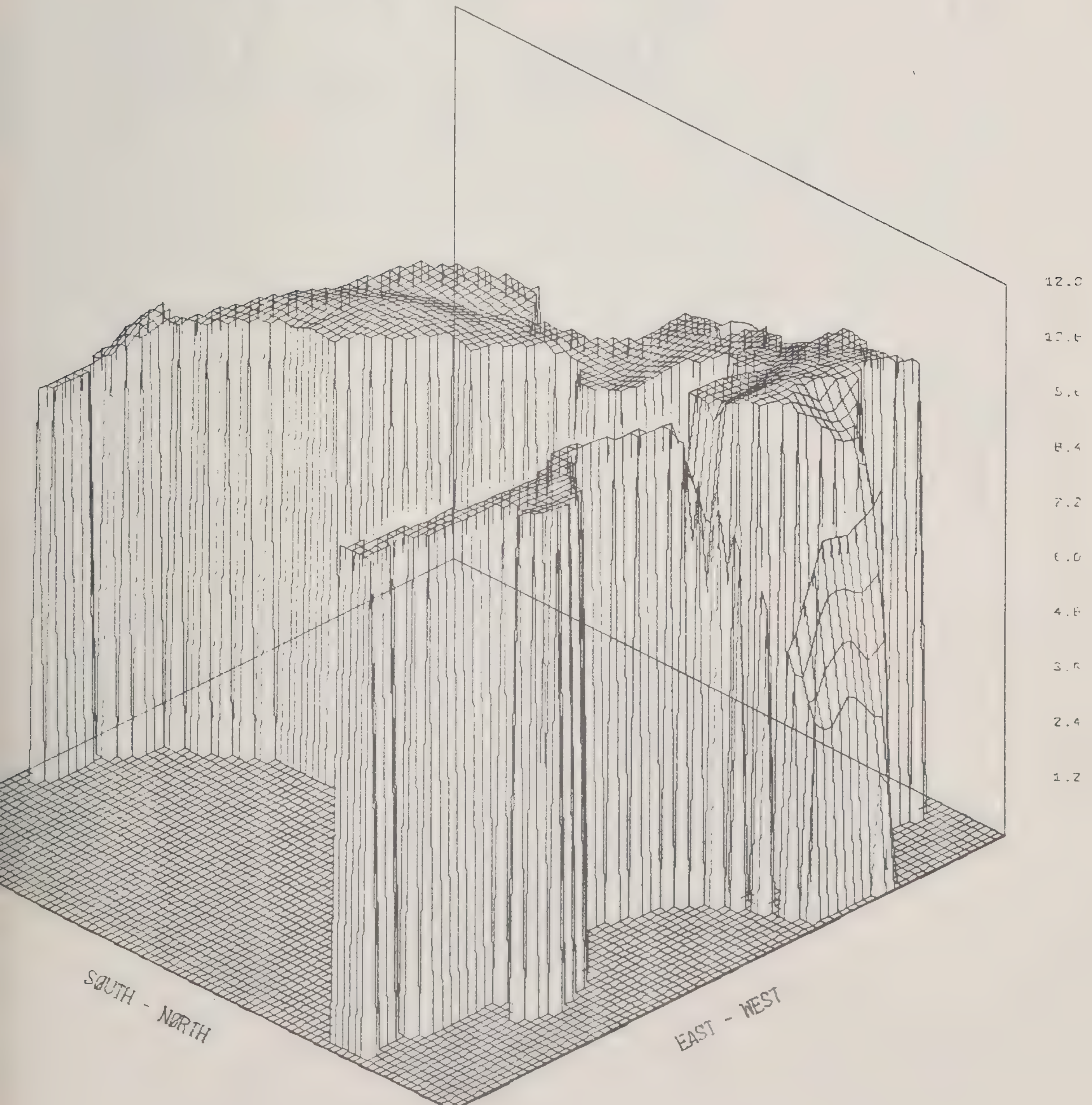

BØD5 (MG/L)--1975 (AFTER STØRM)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
SØUTH - NØRTH
EAST - WEST

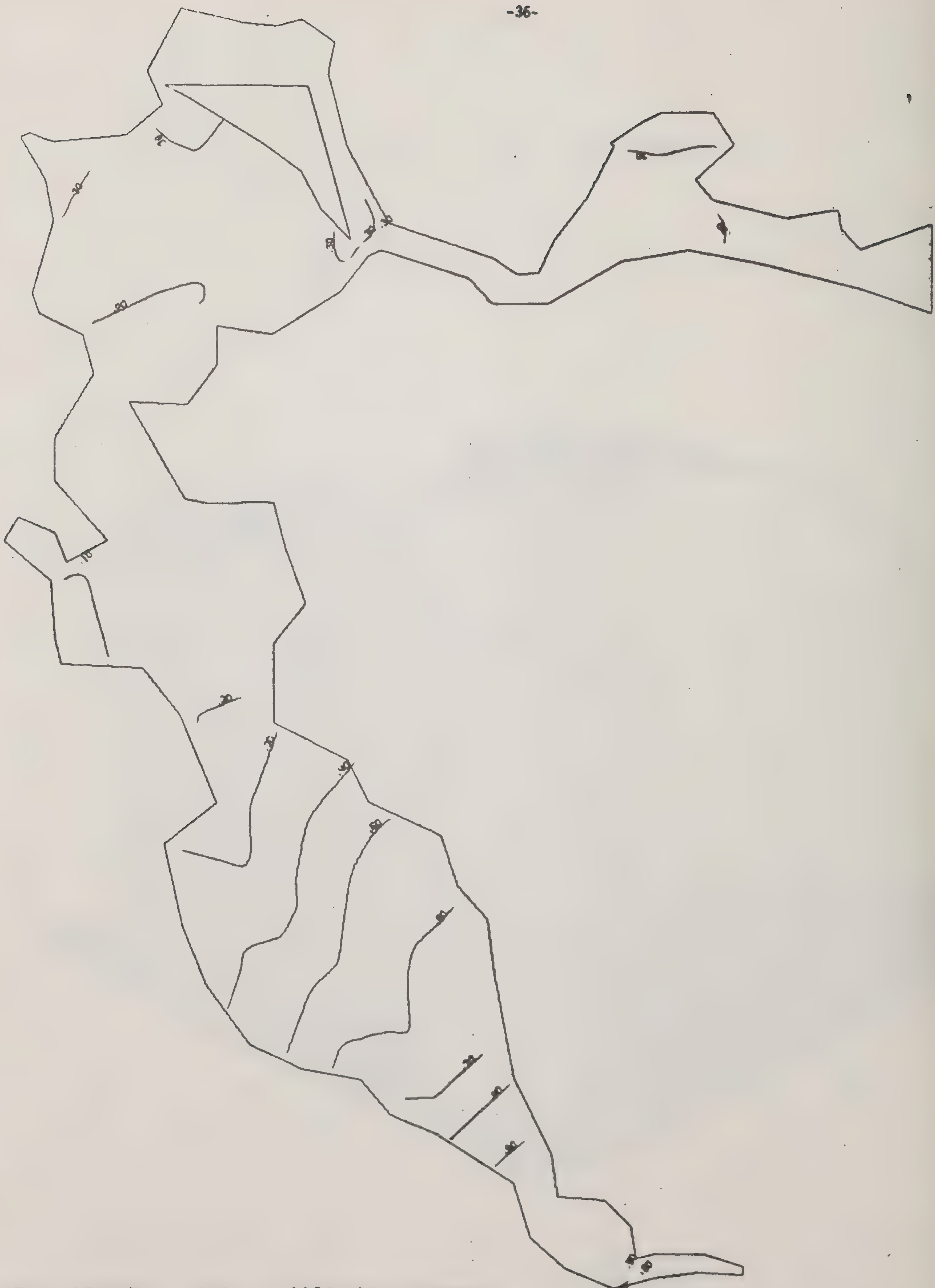


HIGH VALUE = 10.91 INTERVAL .25

DISSOLVED OXYGEN (MG/L)--1975 (AFTER STORM)

DISSØLVED ØXYGEN (MG/L)--1975 (AFTER STØRM)

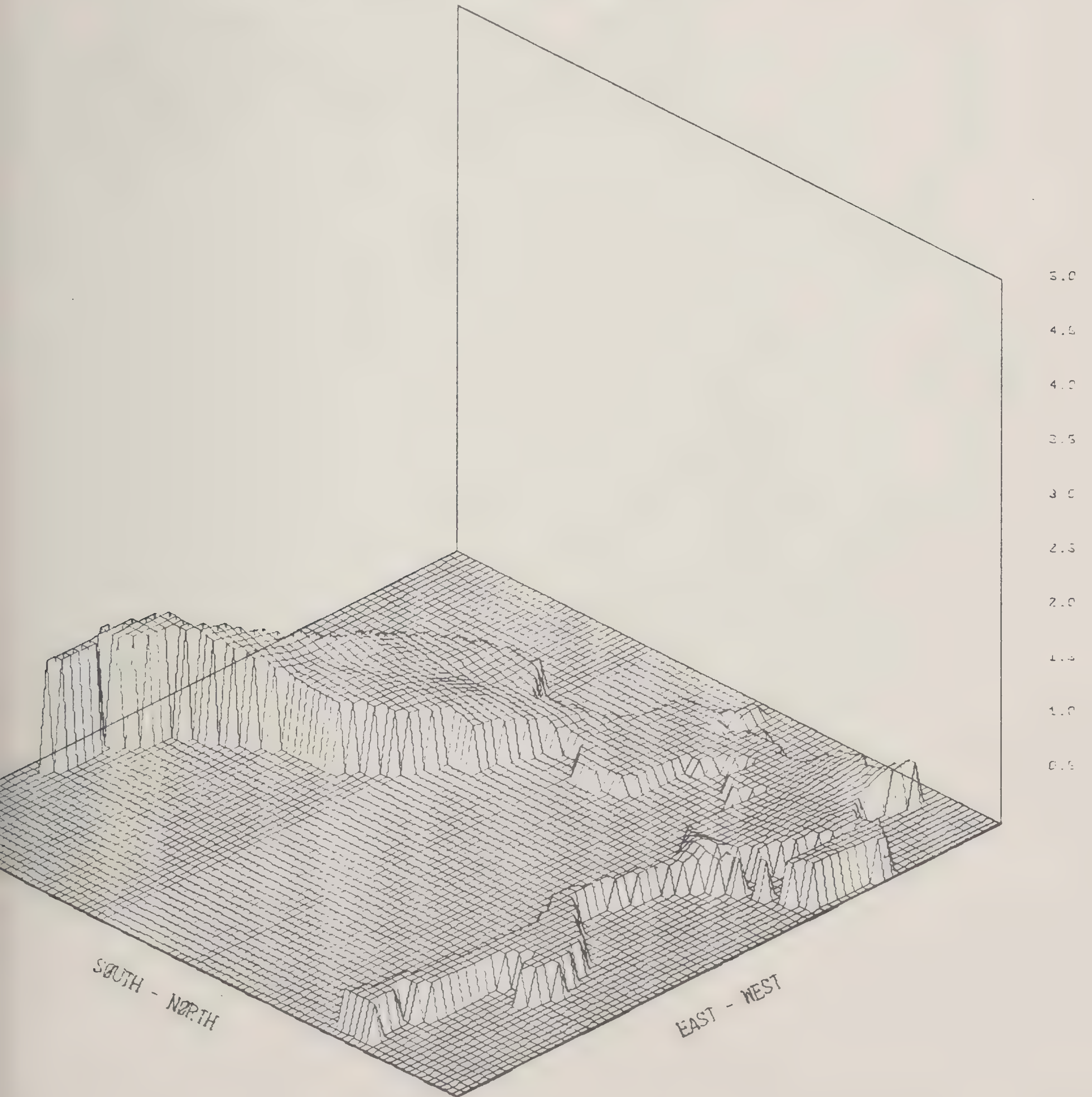


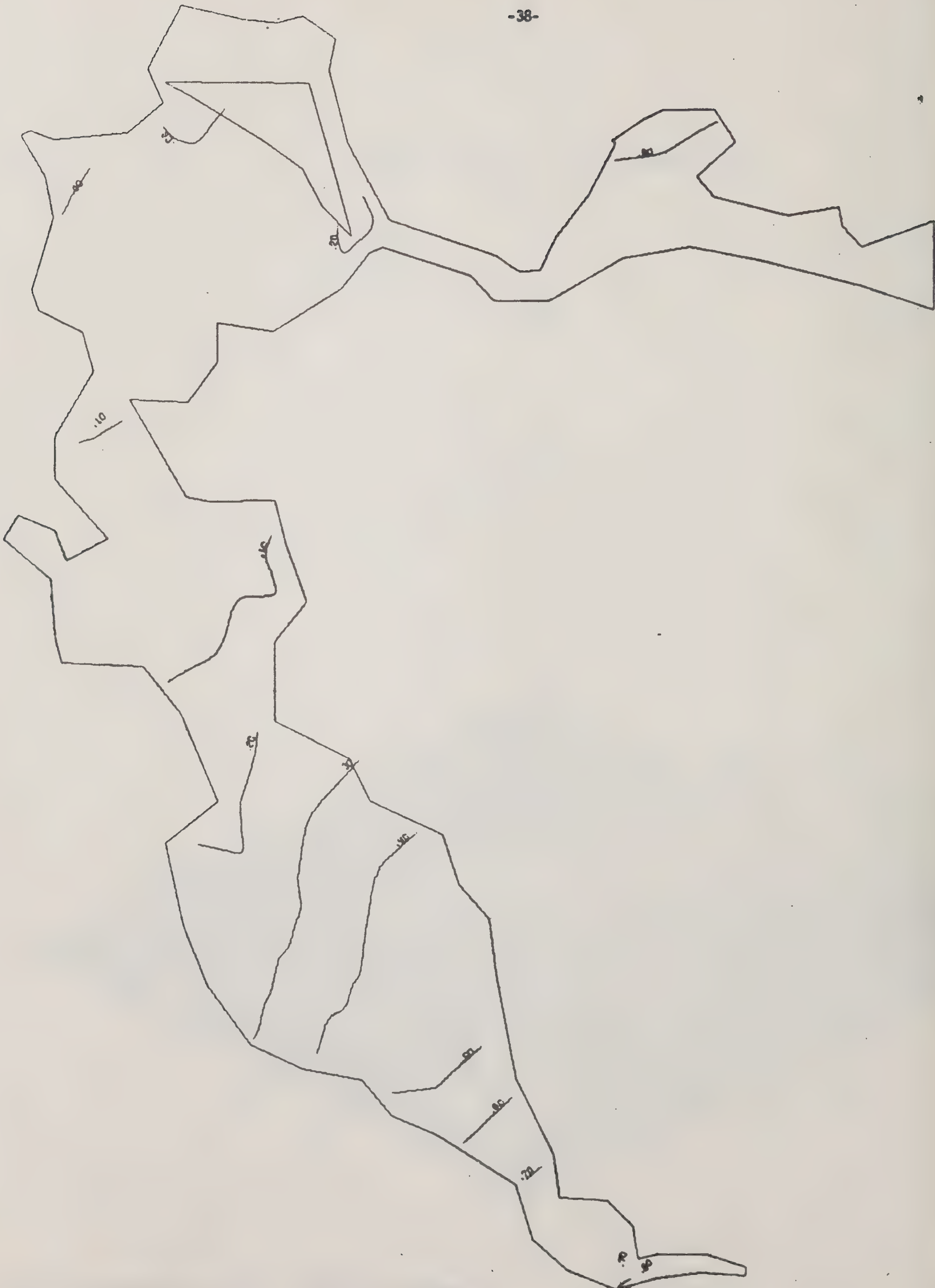


TOTAL NITROGEN (MG/L)--2000 (DRY SEASON)

HIGH VALUE = .98 INTERVAL .10

TØTAL NITRØGEN (MG/L)--2000 (DRY SEASØN)

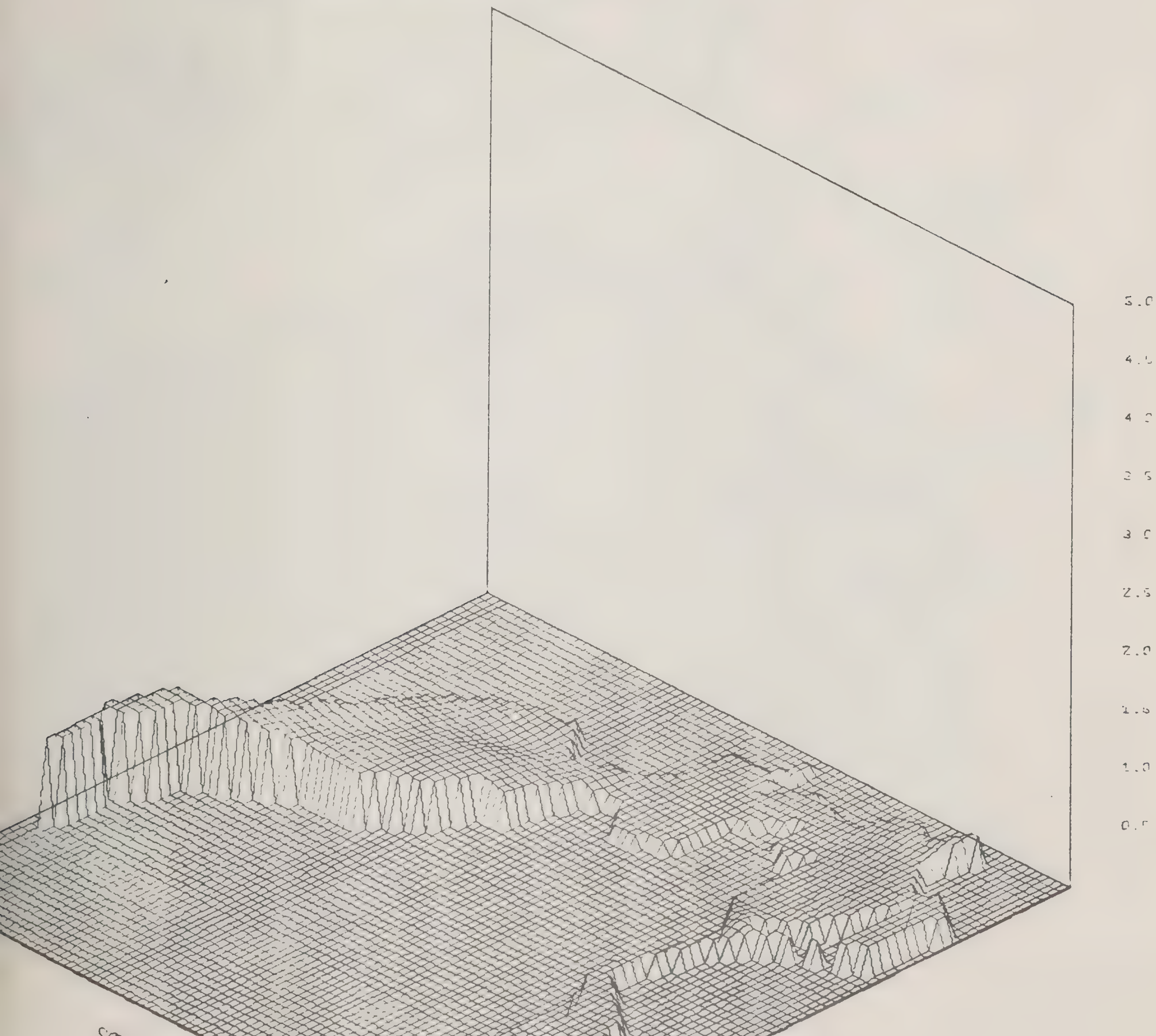


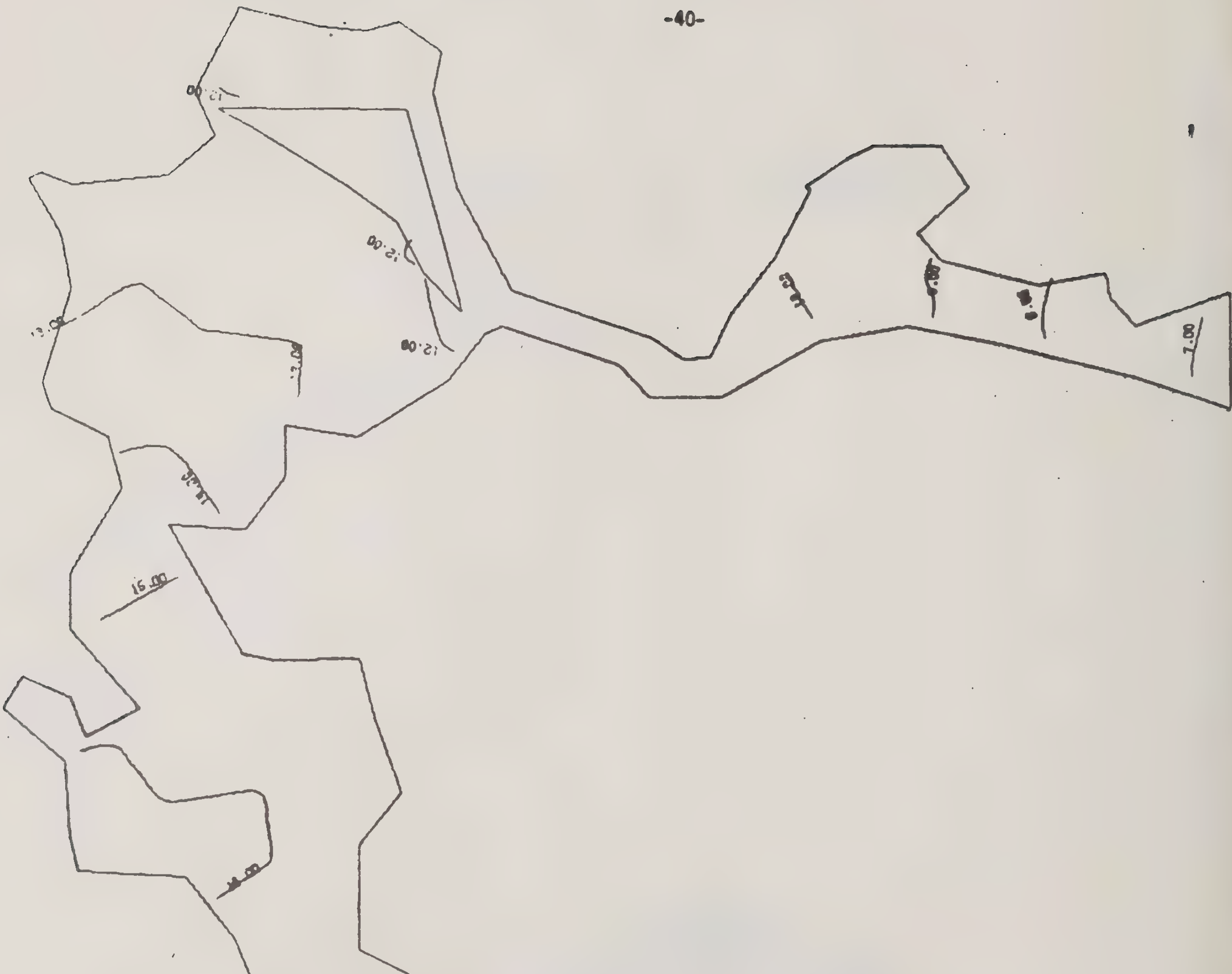


TOTAL PHOSPHOROUS (MG/L)--2000 (DRY SEASON)

HIGH VALUE = .72 INTERVAL .10

TØTAL PHØSPHØRØUS (MG/L)--2000 (DRY SEASØN)

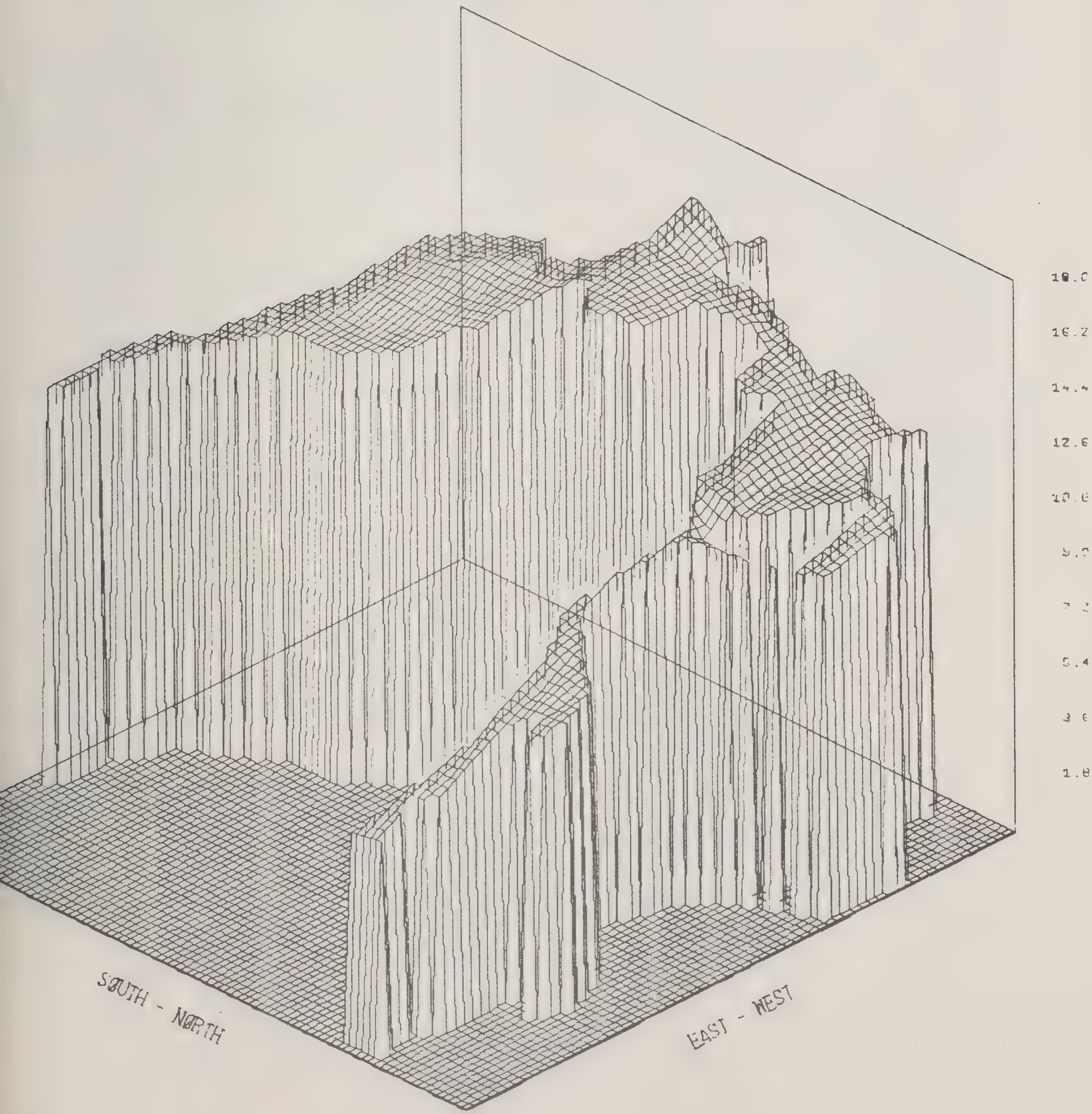


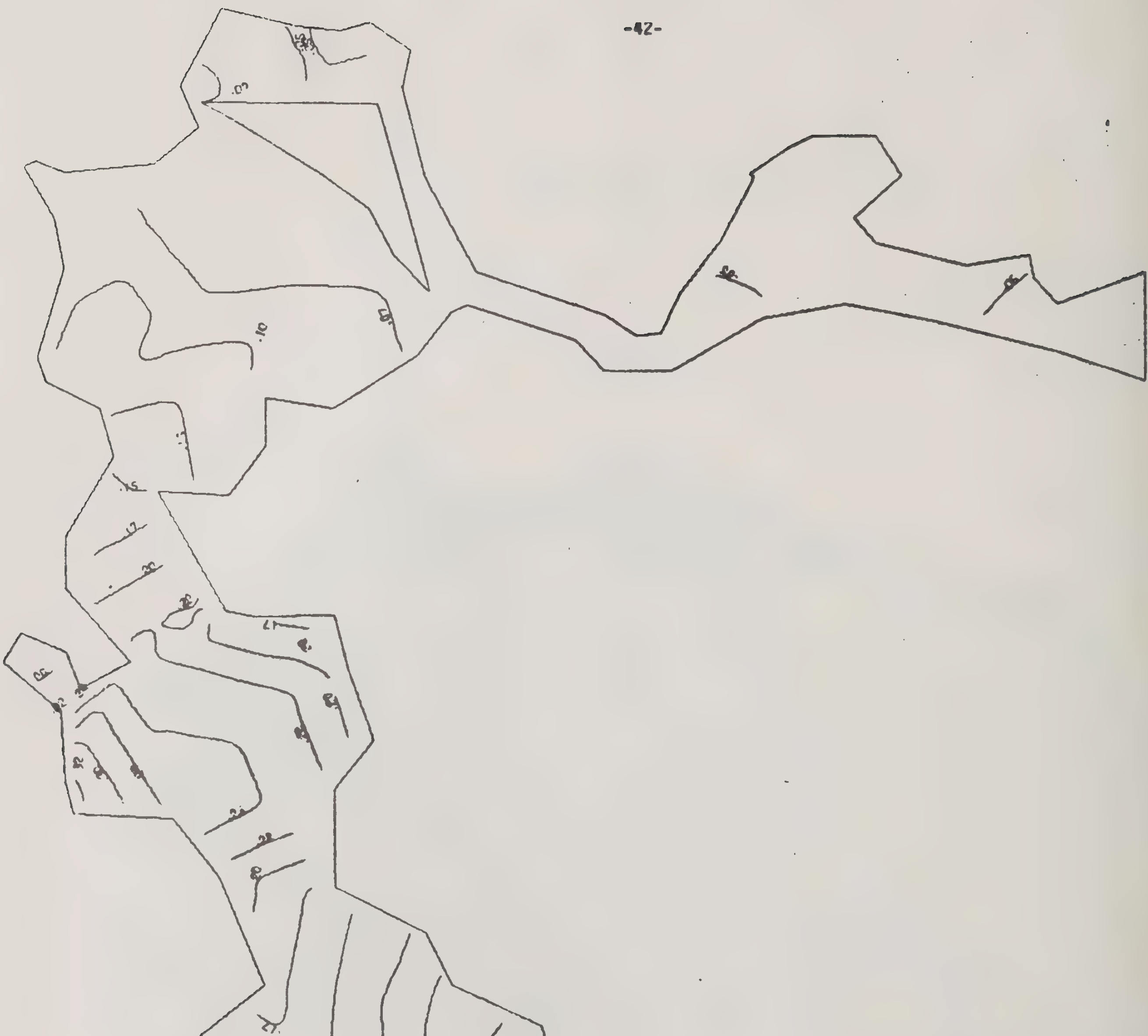


CHLORIDE/1000 (MG/L)--2000(DRY SEASON)

HIGH VALUE = 16.91 INTERVAL 1.00

CHLØRIDE/1000 (MG/L)--2000(DRY SEASØN)

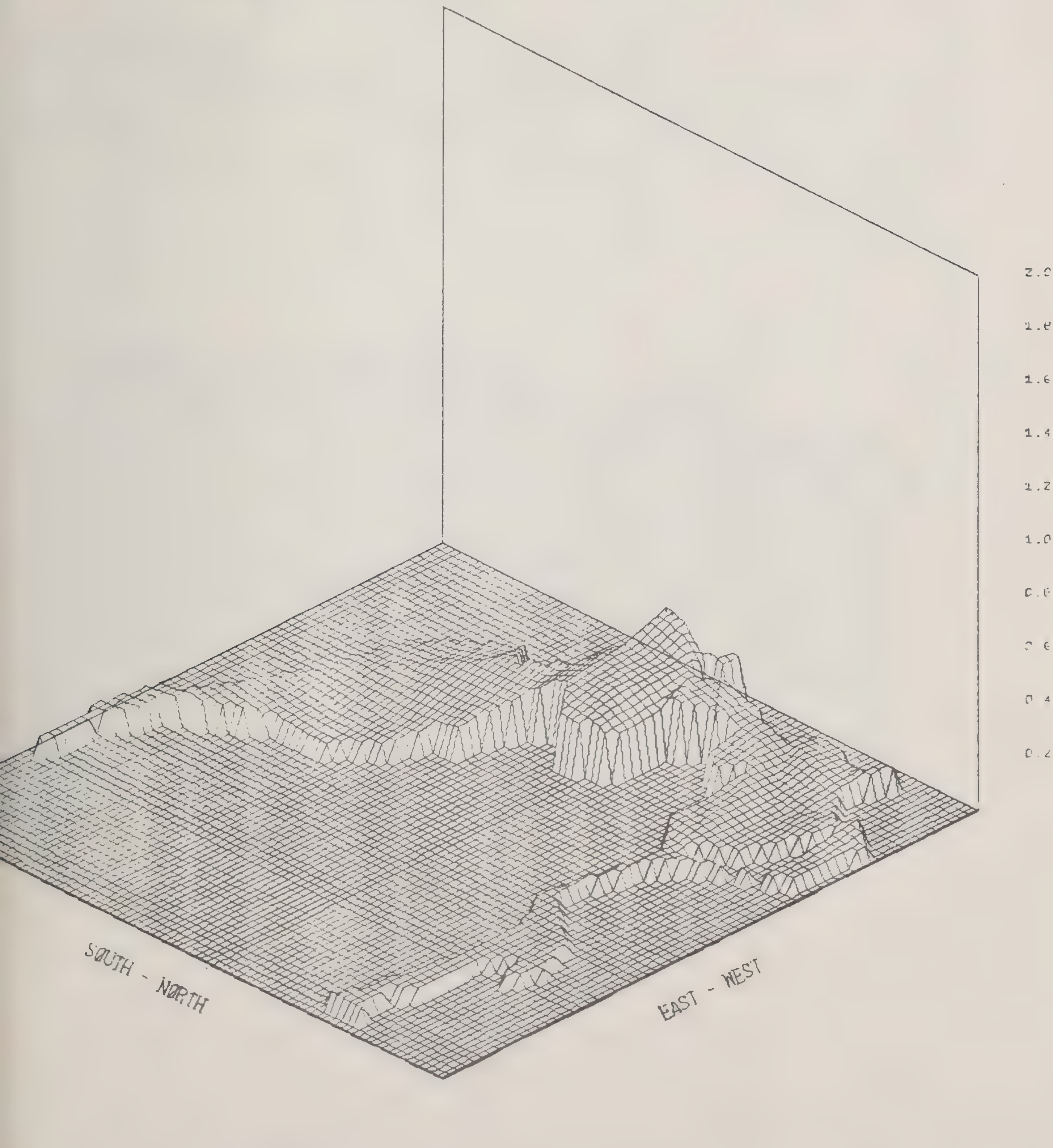




HIGH VALUE = .33 INTERVAL .03

BOD5 (MG/L)--2000 (DRY SEASON)

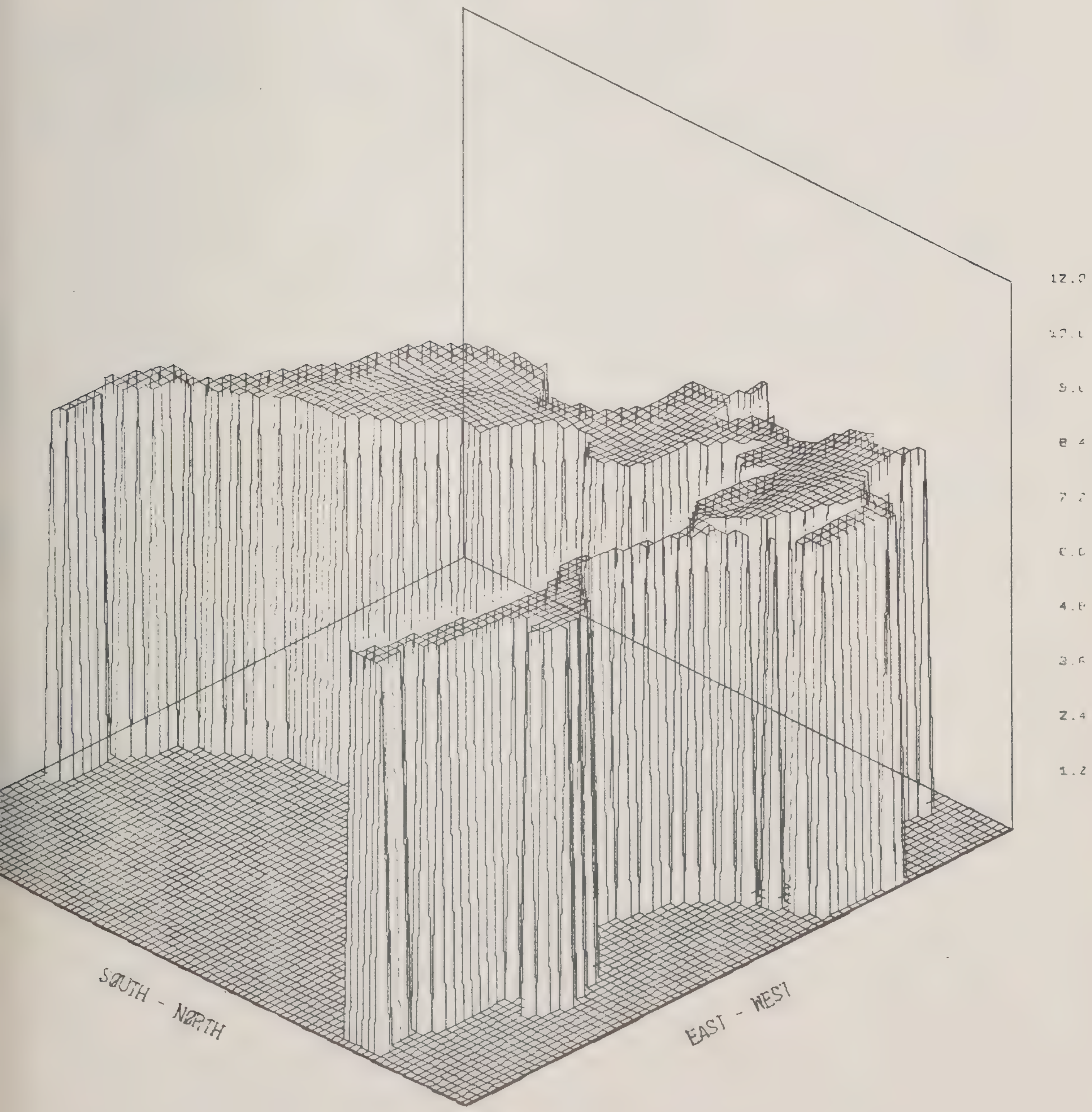
BØD5 (MG/L)--2000 (DRY SEASØN)

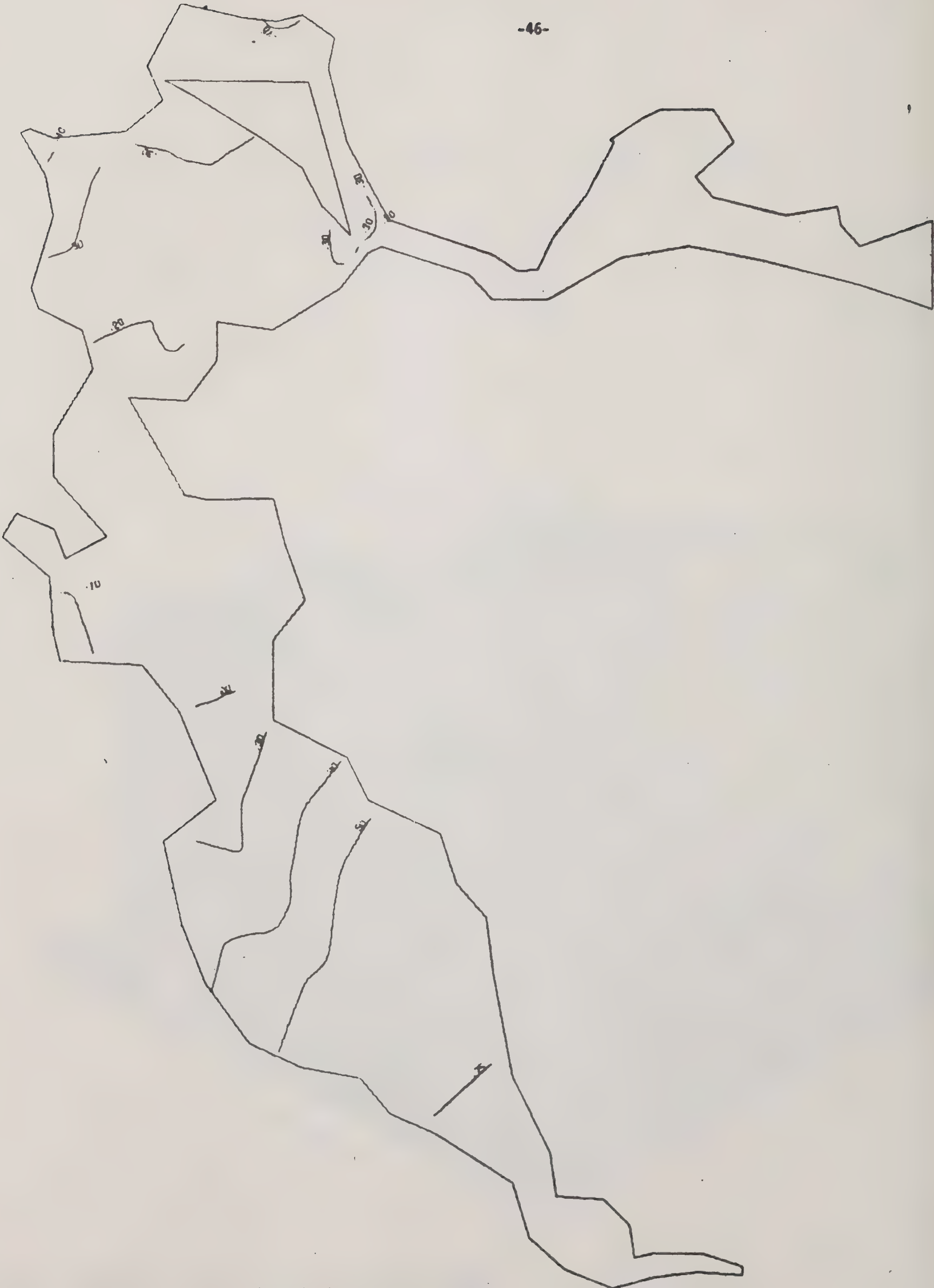


HIGH VALUE = 8.39 INTERVAL .25

DISSOLVED OXYGEN (MG/L)--2000 (DRY SEASON)

DISSØLVED ØXYGEN (MG/L)--2000 (DRY SEASØN)

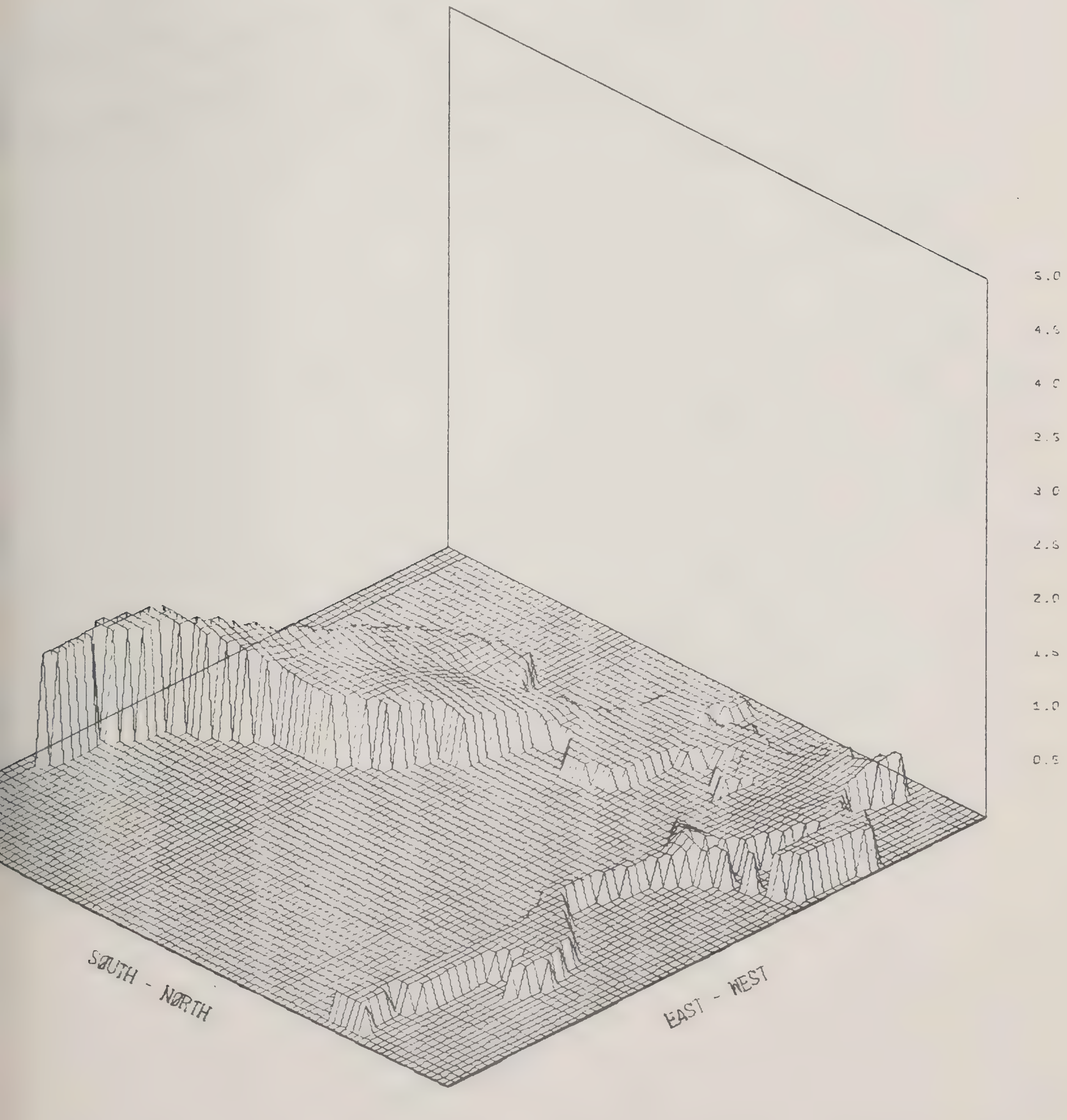


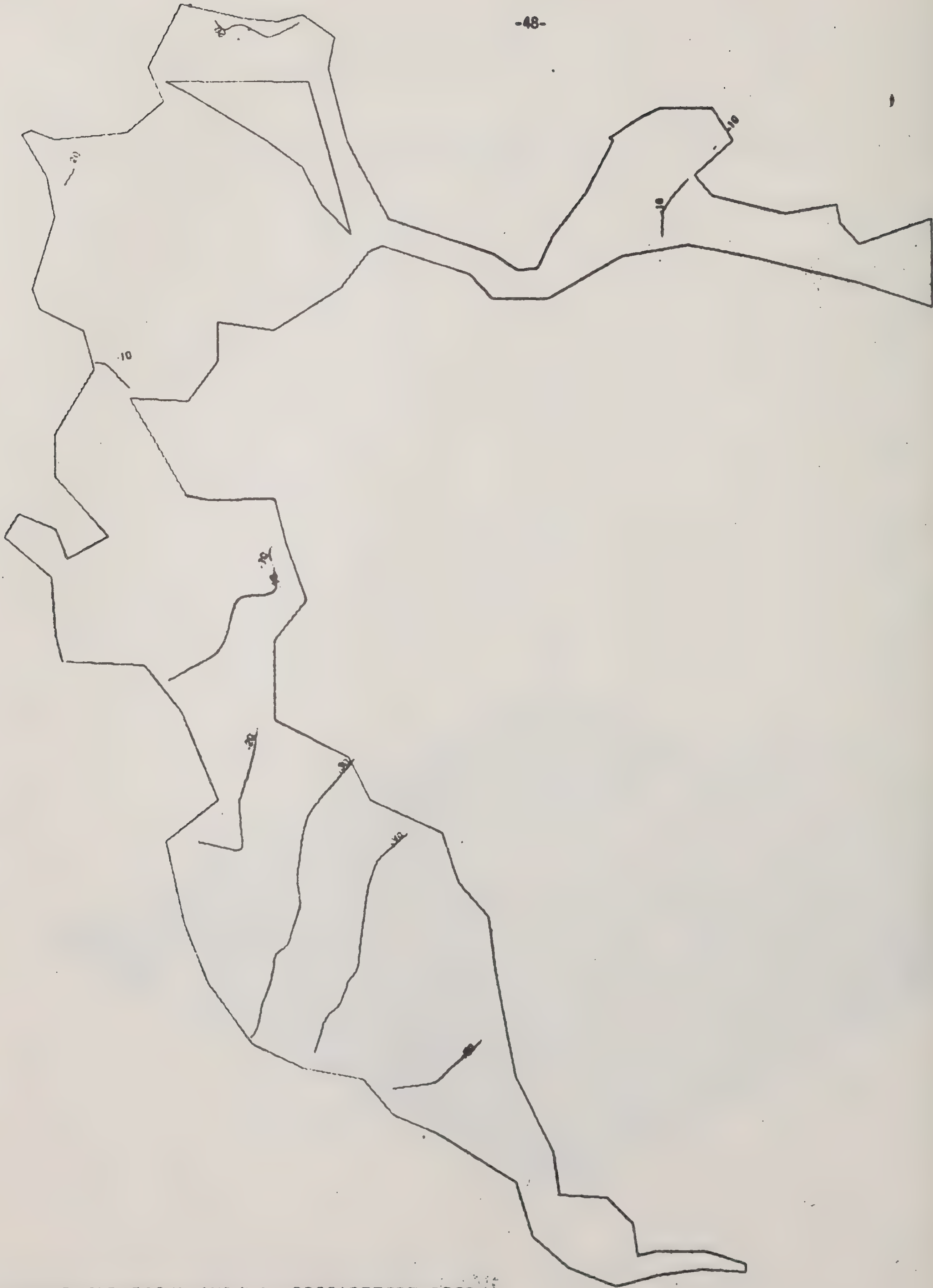


TOTAL NITROGEN (MG/L)--2000(BEFORE STORM)

HIGH VALUE = 1.00 INTERVAL .25

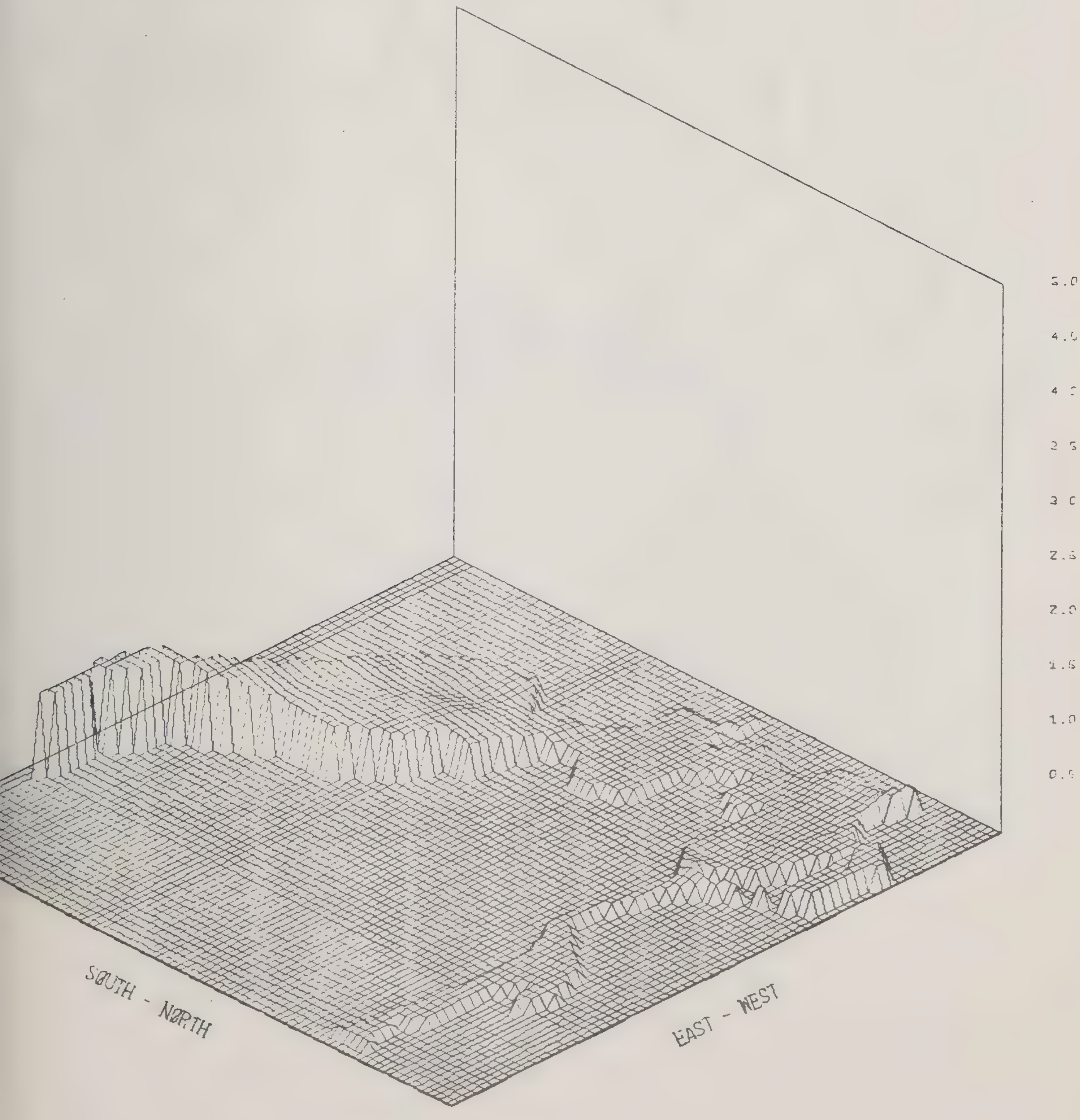
TØTAL NITRØGEN (MG/L)--2000(BEFØRE STØRM)





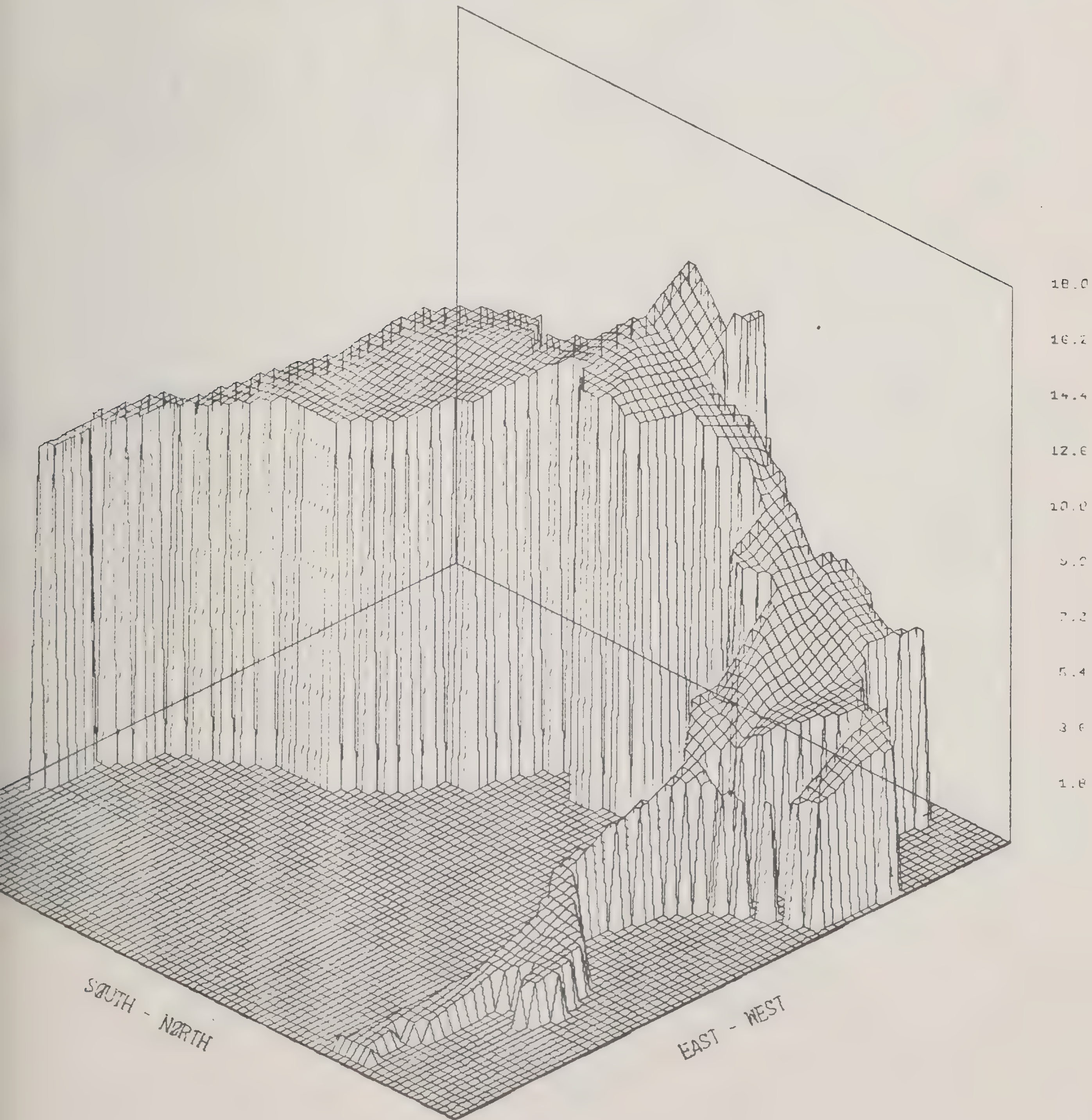
TOTAL PHOSPHOROUS (MG/L)--2000(BEFORE STORM)

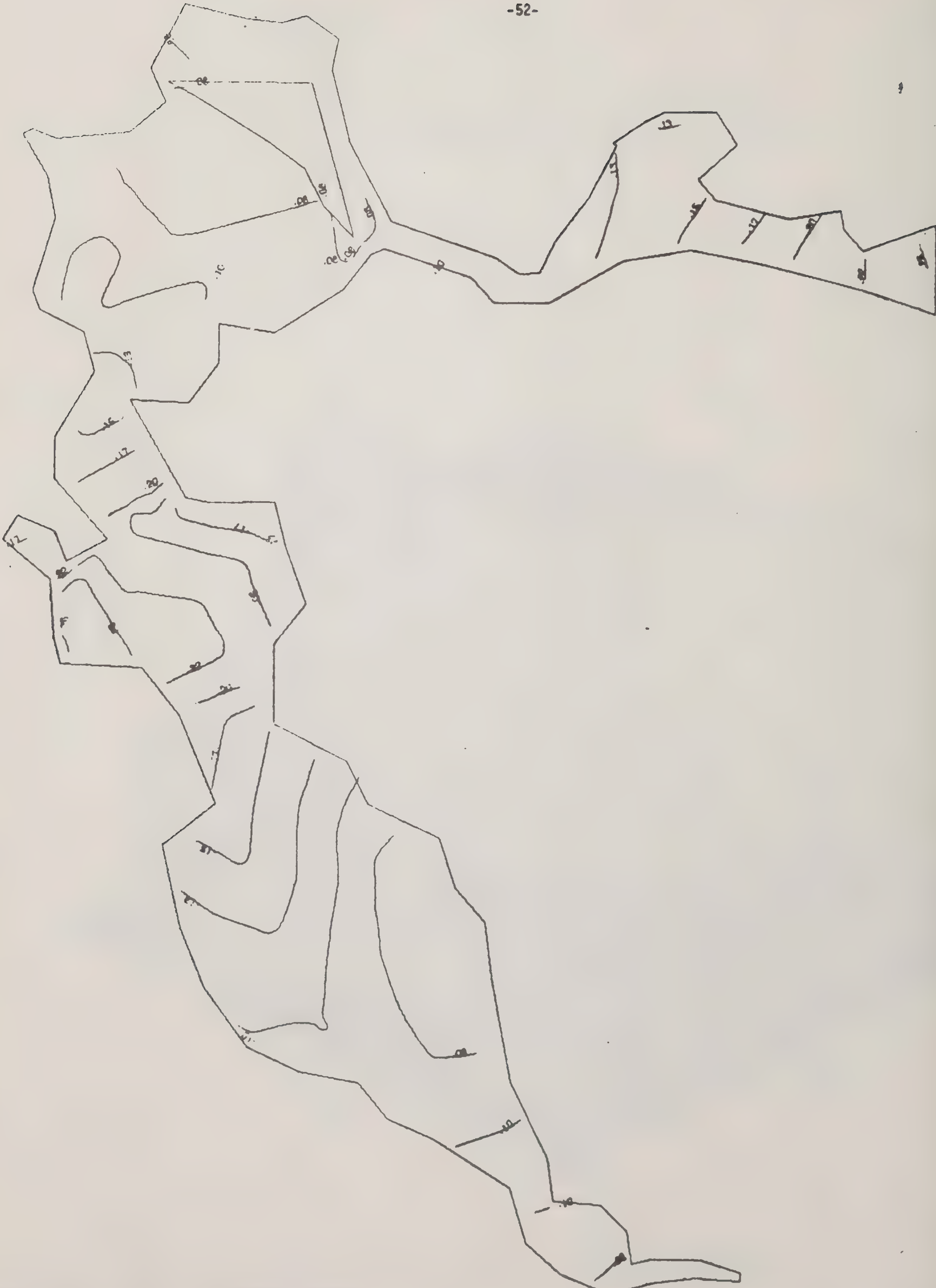
TØTAL PHØSPHØRØUS (MG/L)--2000(BEFØRE STØRM)



CHLORIDE/1000 (MG/L)--2000(BEFORE STORM)

CHLØRIDE/1000 (MG/L)--2000(BEFØRE STØRM)

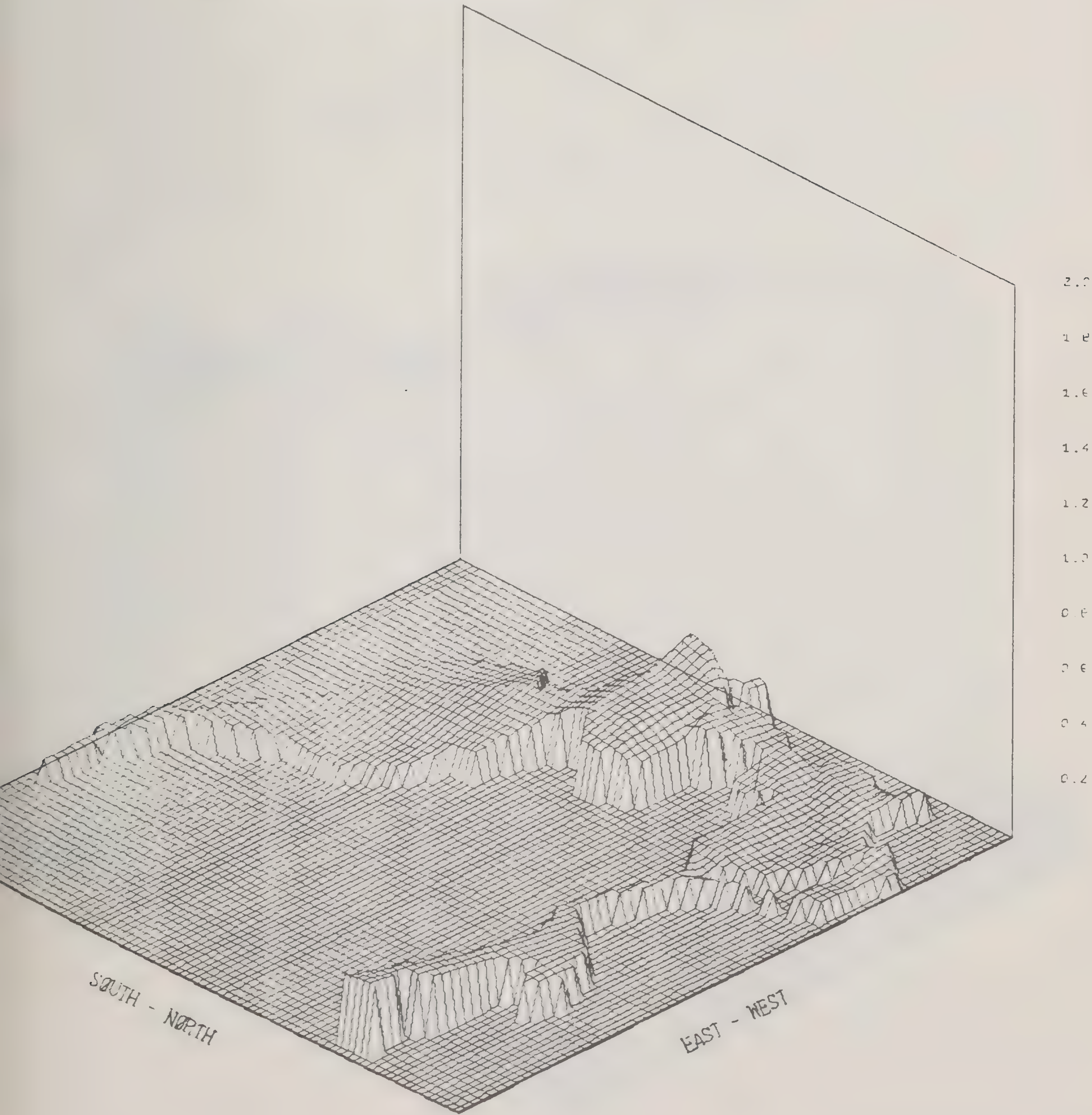




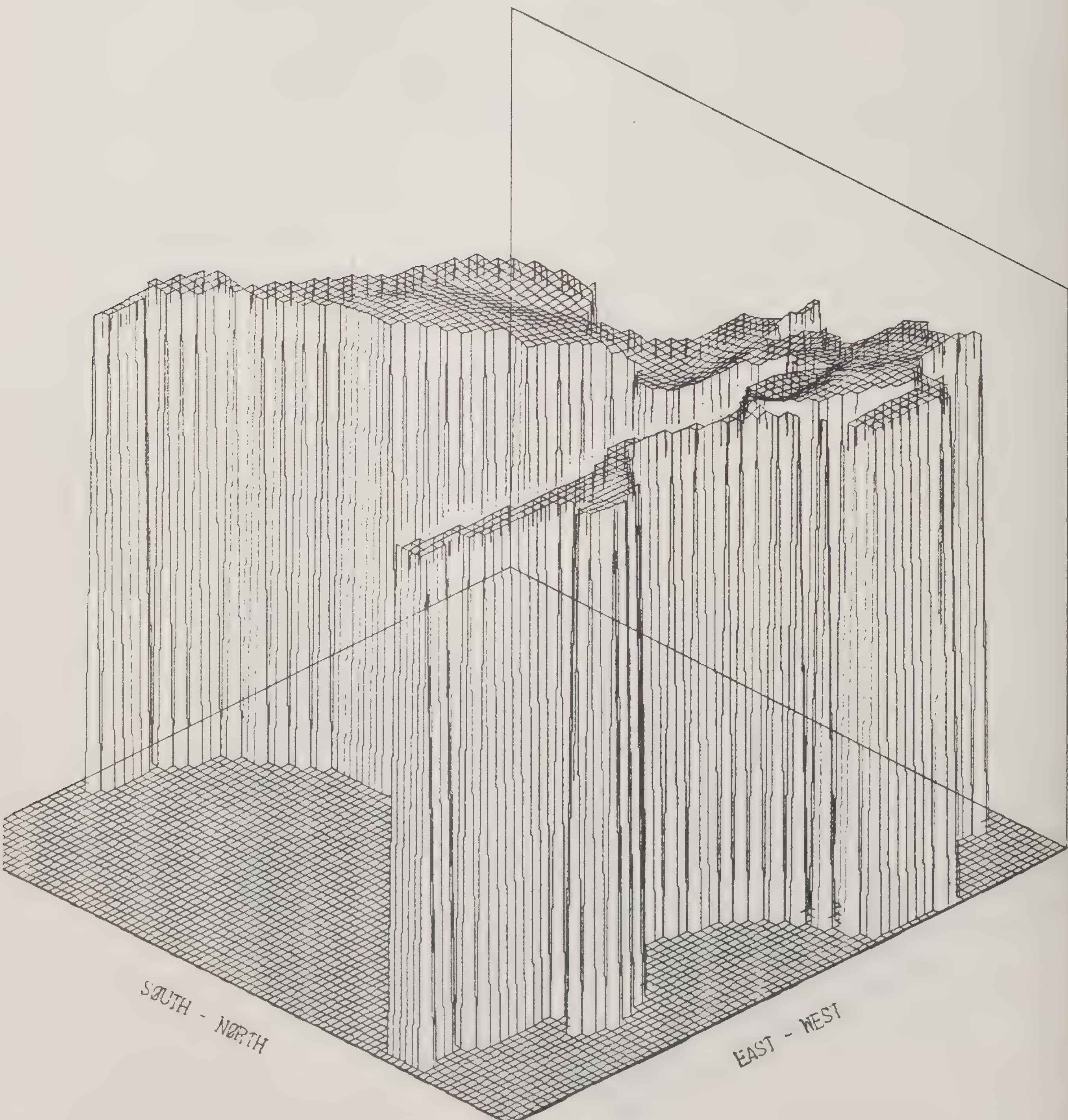
HIGH VALUE = [illegible] INTERVAL .05

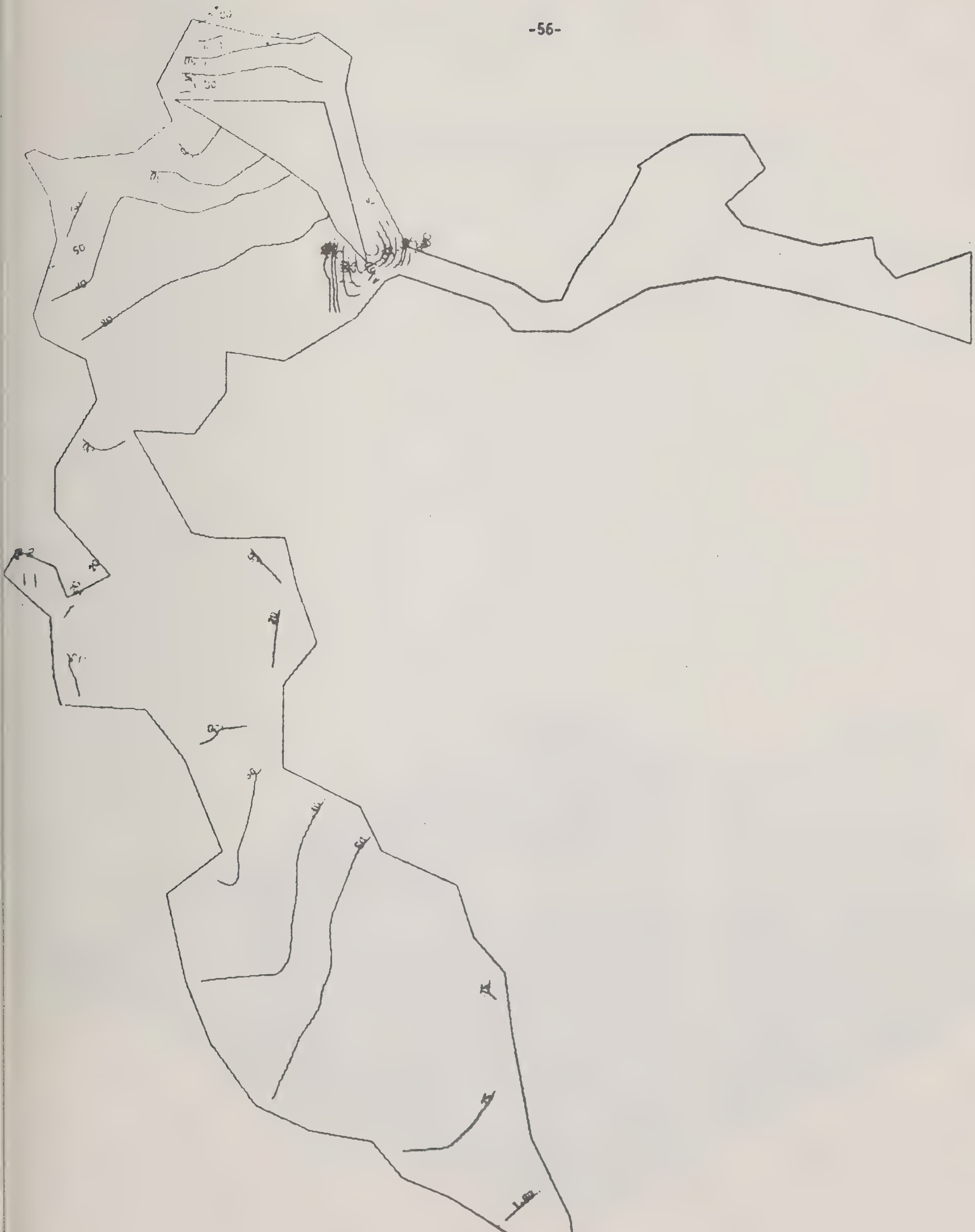
BODS (MG/L)--2000 (BEFORE STORM)

BØD5 (MG/L)--2000 (BEFØRE STØRM)



DISSØLVED ØXYGEN (MG/L)--2000(BEFØRE STØRM)

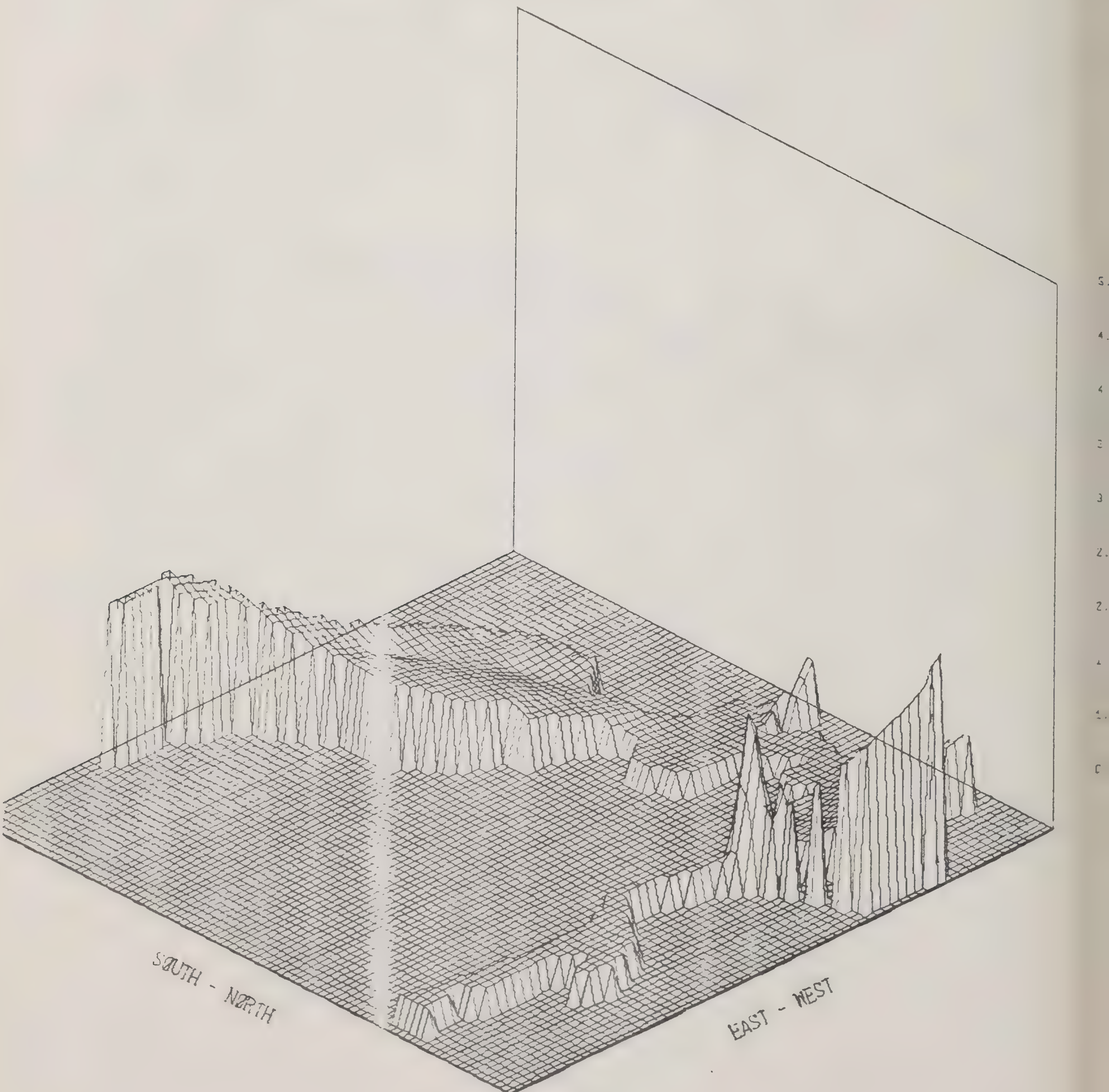


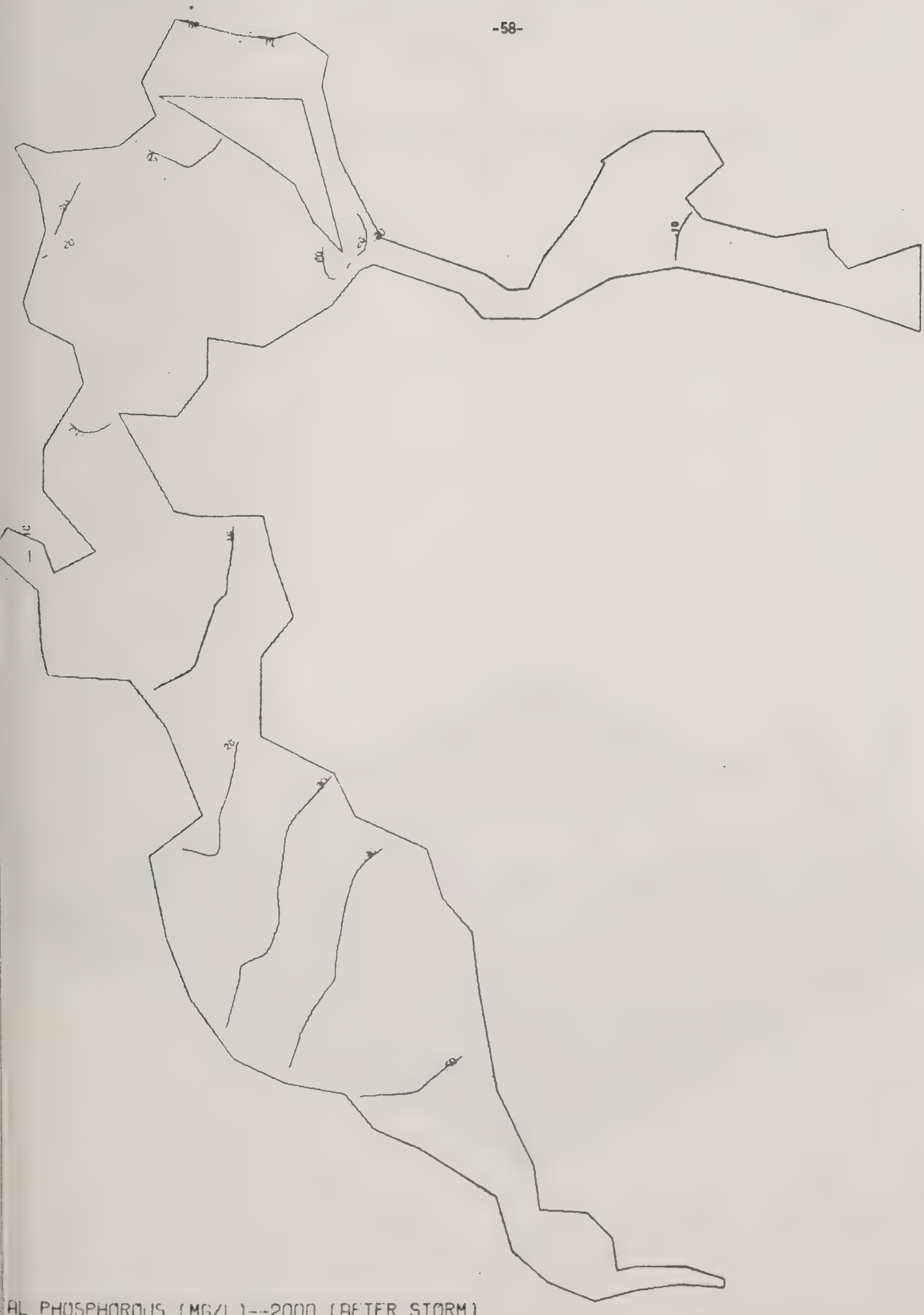


HIGH VALUE = 2.07 INTERVAL .25

TAL NITROGEN (MG/L)--2000 (AFTER STORM)

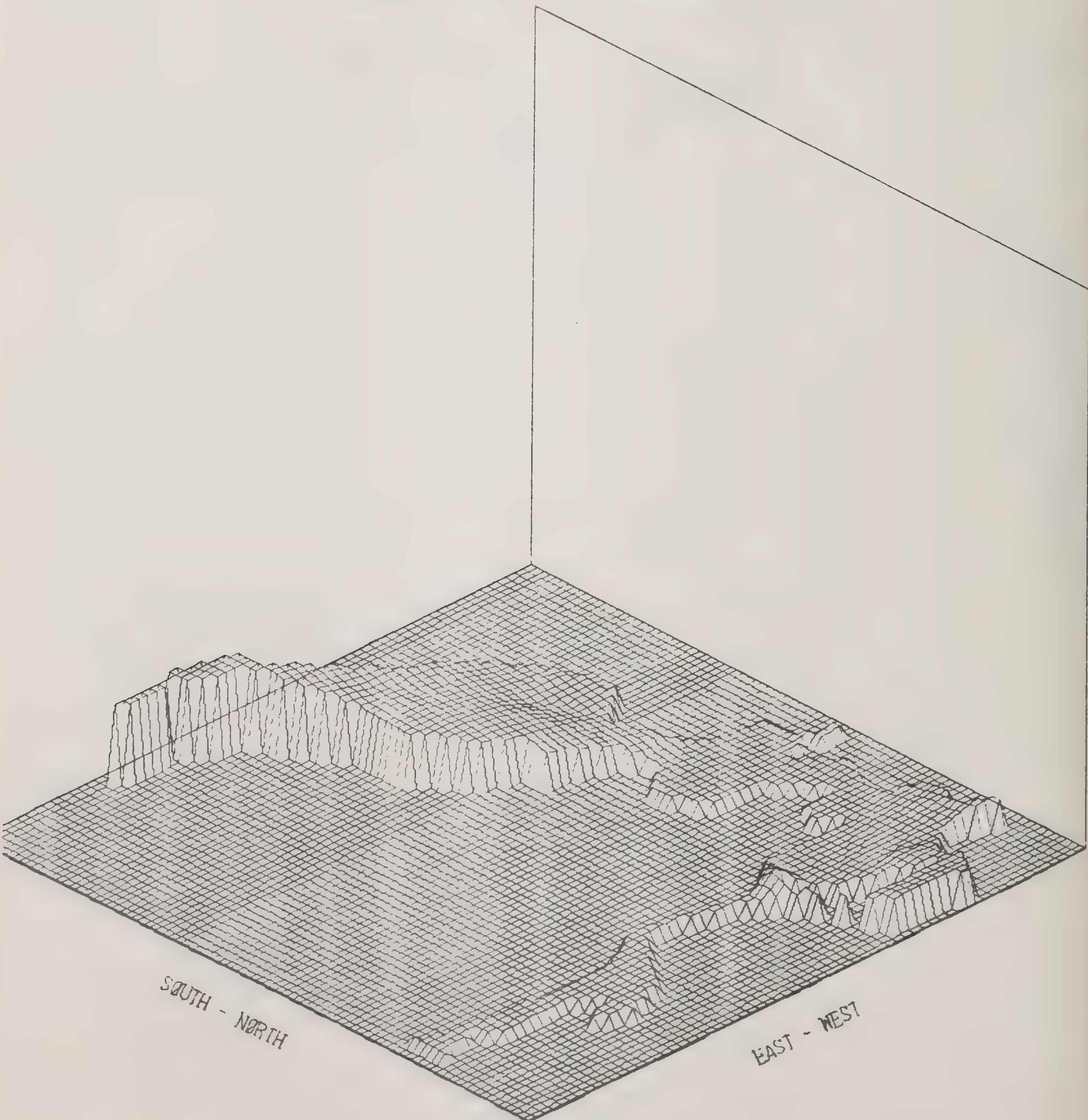
TØTAL NITRØGEN (MG/L)--2000 (AFTER STØRM)

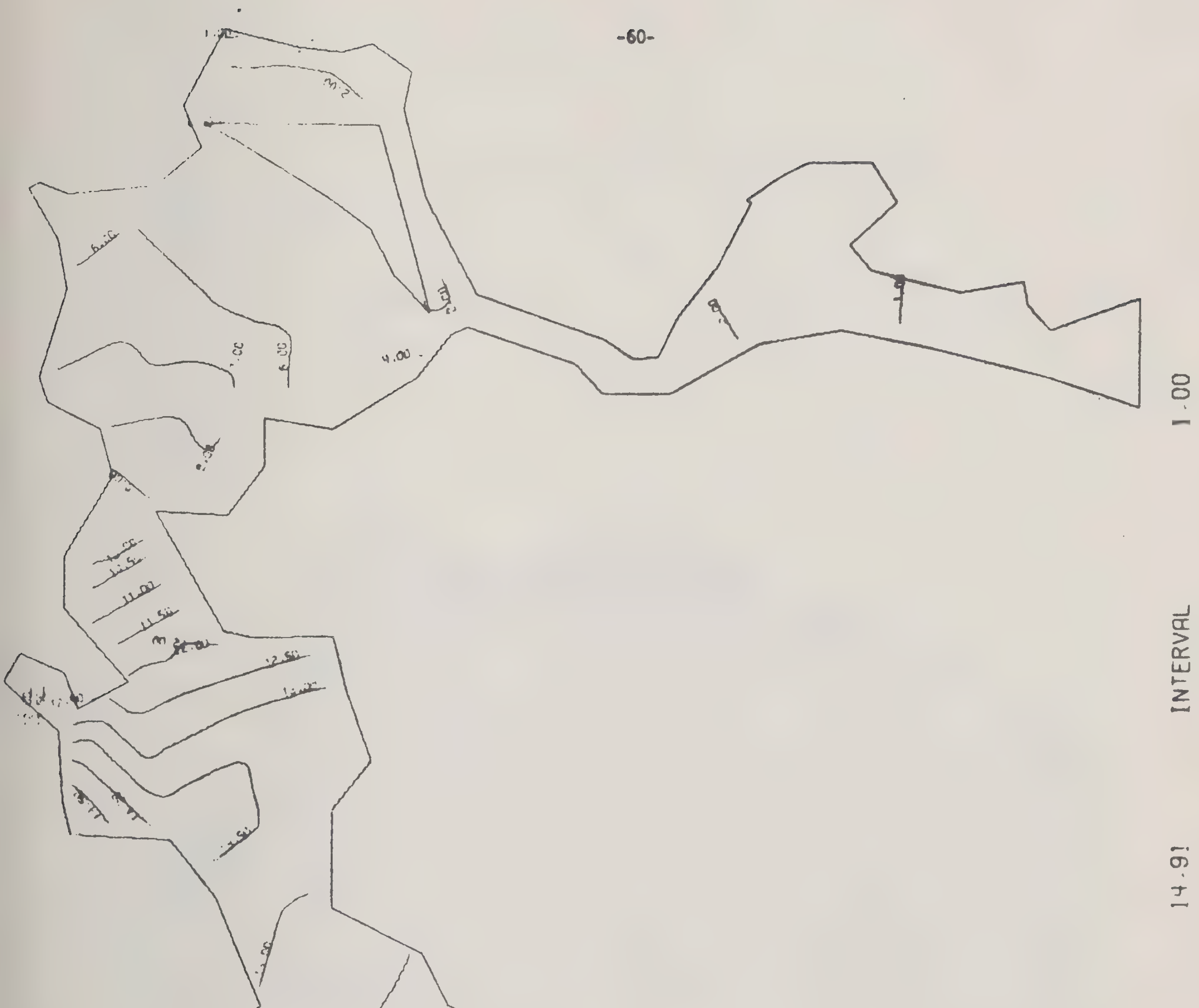




AL PHOSPHOROUS (MG/L)--2000 (AFTER STORM)

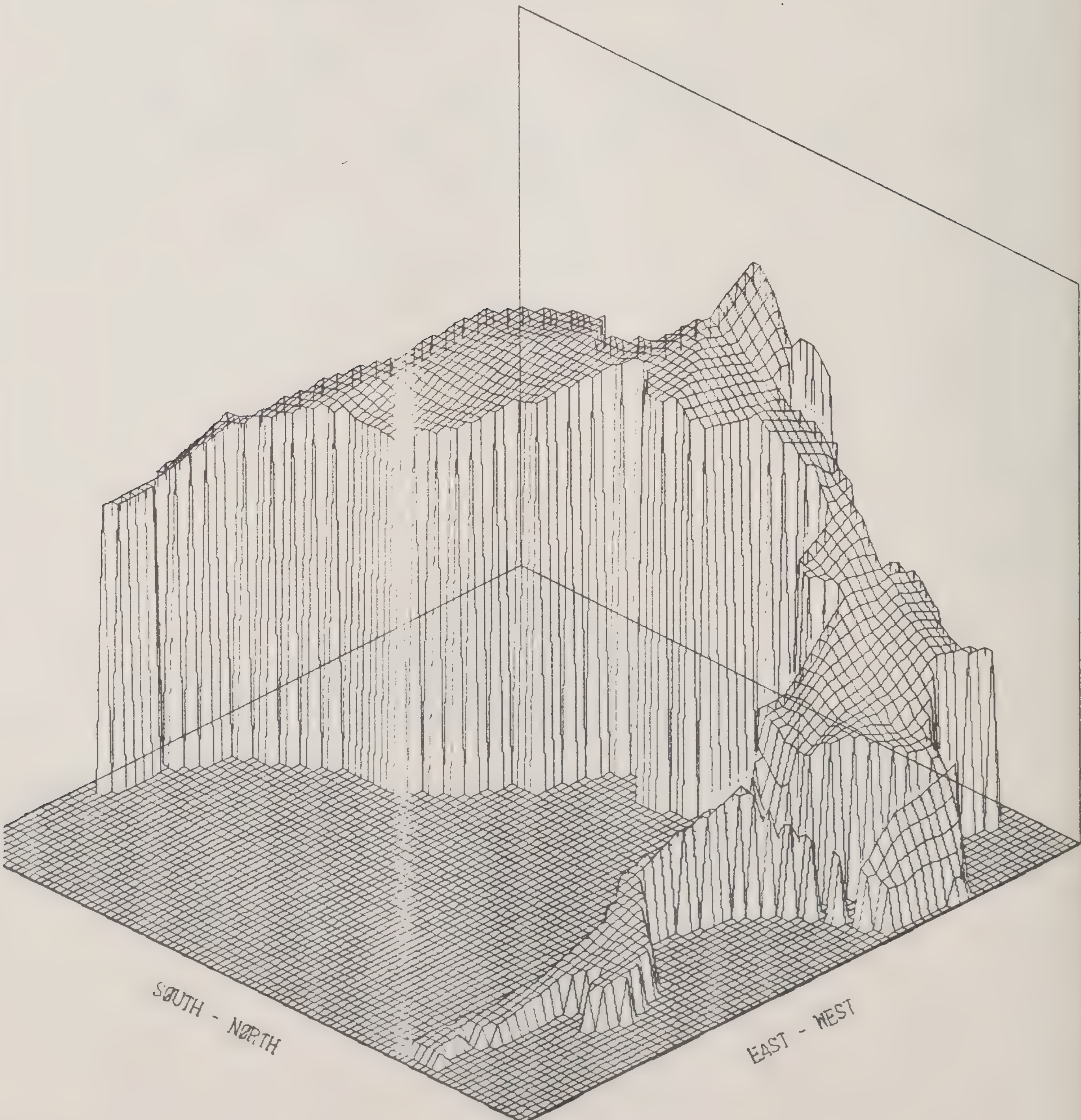
TØTAL PHØSPHØRØUS (MG/L)--2000 (AFTER STØRM)





HLORIDE/1000 (MG/L)--2000 (AFTER STORM)

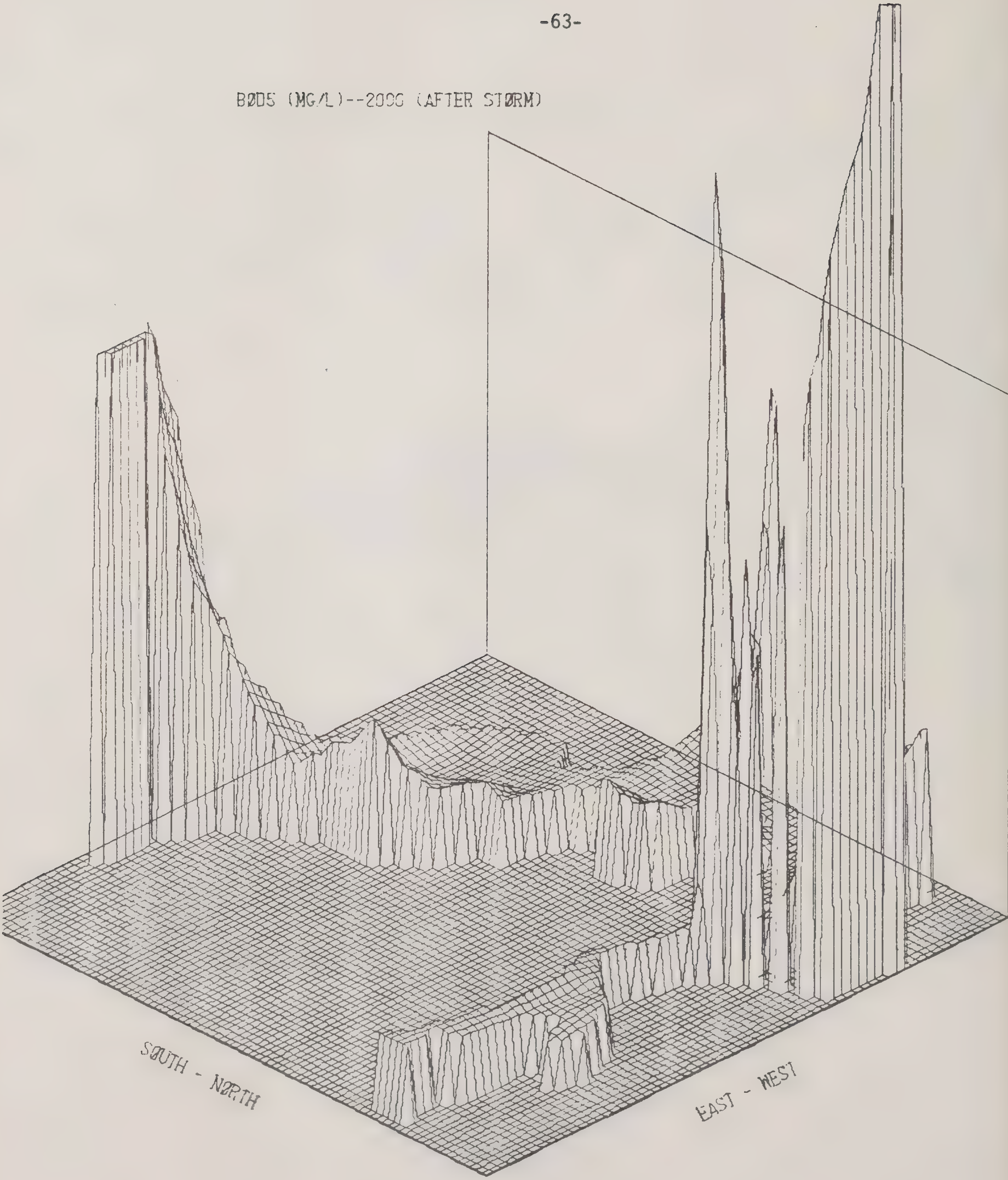
CHLØRIDE/1000 (MG/L)--2000 (AFTER STØRM)

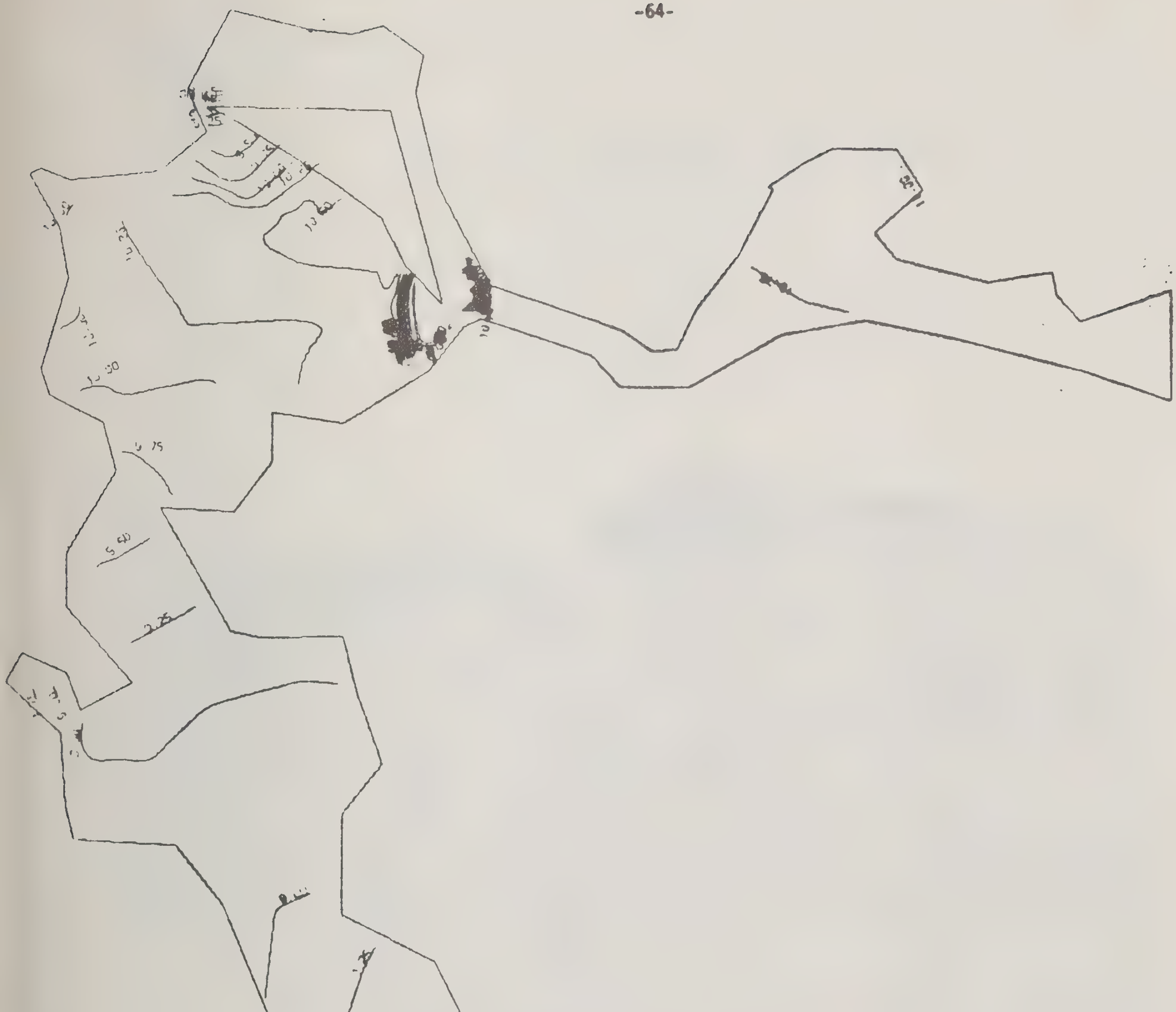


HIGH VALUE = 4 93 INTERVAL .05

BODS (MG/L)--2000 (AFTER STORM)

BØD5 (MG/L)--2000 (AFTER STØRM)

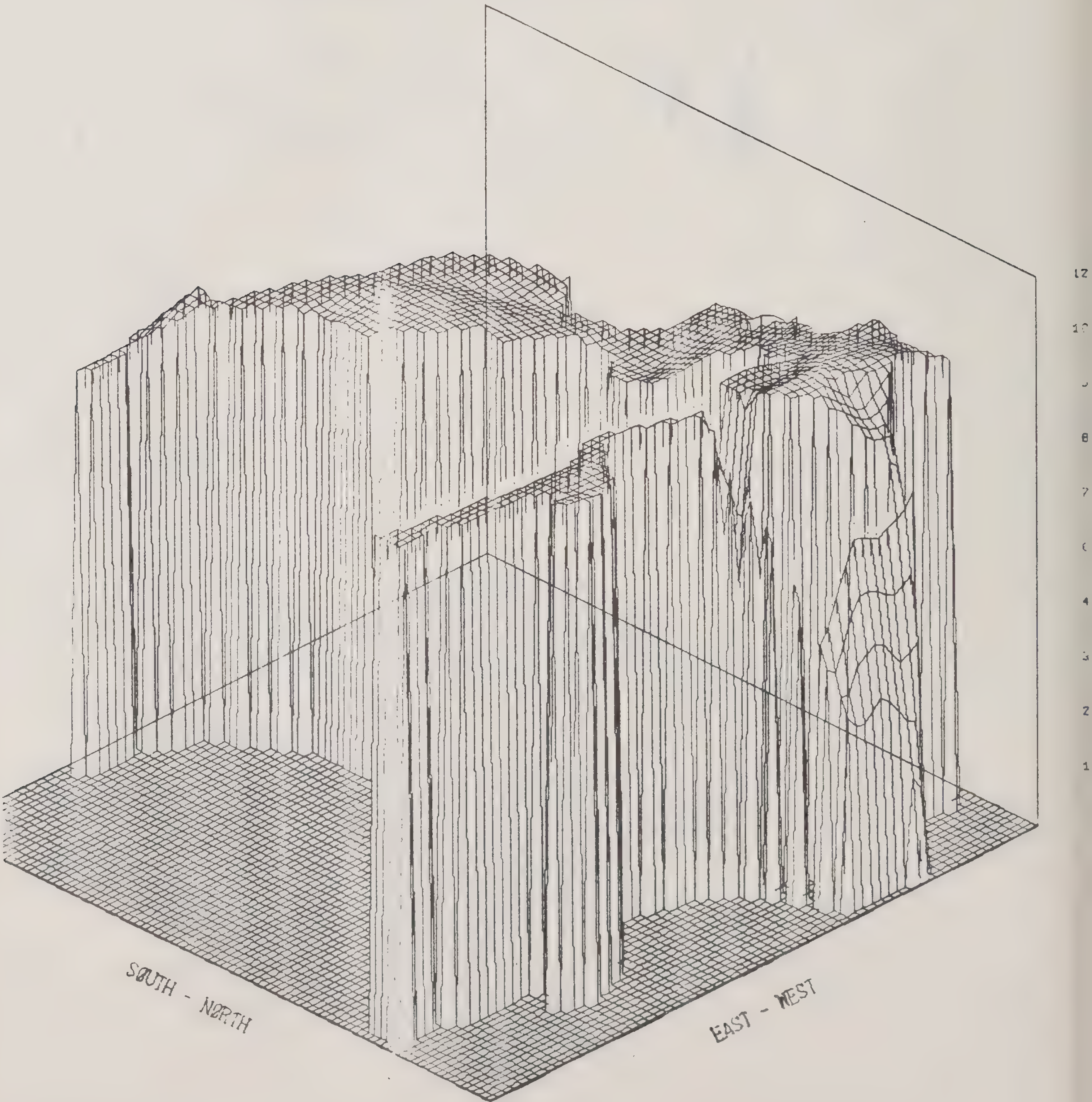




HIGH VALUE = 11.02 INTERVAL .25

ISSOLVED OXYGEN (MG/L)--2000 (AFTER STORM)

DISSØLVED ØXYGEN (MG/L)--2000 (AFTER STØRM)



WQ/Tech Memo 22/July, 1977
T. Bursztynsky

Water Quality Management Plans

Oil and Chemical Spills

Technical Memorandum No. 22

July, 1977
Revised March, 1978

INTRODUCTION

Oil and chemical spills, due to their unexpected, infrequent (from any single source), and intermittent nature, pose a unique waste management problem. The potentially severe impacts of oil and chemical spills upon the environment include fish kills, zooplankton destruction, damage to beach communities including commercial oysters and clam beds, fouling of beaches and reduction of aesthetic qualities, bird and mammal kills, and under unique circumstances, harm to human health. These impacts demand that, although control may be difficult to achieve, every reasonable measure be employed to prevent oil and chemical spills, and cleanup procedures be diligently applied to reduce damage from spills.

A special study report on oil and chemical spills has been prepared by ABAG staff as part of the Environmental Management Plan (EMP) effort. This report, entitled "A Survey of Prevention Measures and Contingency Planning for Oil and Hazardous Material Spills in the San Francisco Bay Area," specifically addresses the topics of:

1. Spill occurrence in the Bay Area.
2. Legislative and regulatory aspects of spill prevention and cleanup.
3. Current procedures for spill prevention and cleanup.

This report is presented in its entirety as appended to this memorandum. The oil and chemical spills management plan uses the special study document as the basis for identification of management deficiencies and preparation of recommended solutions. Consequently, this technical memorandum will not duplicate information presented in the special study's report. Rather, the following material will be presented:

1. Introduction and problem statement.
2. Summary of problem areas.
3. Solutions suggested for further analysis.

The special study report has been reviewed by an EMP technical advisory committee (TAC). Many of their comments are reflected in this current and final version of the report. However, the topic of oil and chemical spill regulation is extremely complex with interleaving, and sometimes conflicting, international, Federal and State regulations. It is possible that error in interpretation or understanding of these regulations may have occurred. ABAG staff urges that the Miscellaneous Sources Advisory Committee carefully review both this technical memorandum and the special study report. We would appreciate it if the committee would bring to our attention any corrections or changes which seem advisable.

SUMMARY OF PROBLEM AREAS

The prevention of oil and chemical spills resides in two arenas: technology; and, regulation and management, including application of technology. The area of technology includes the hardware, analytical techniques, and scientific understanding needed to prevent or identify and clean up spilled materials. Regulation and management encompasses the direction of human activities to prevent spills or minimize their damage.

TECHNOLOGY

Spill Prevention

The prevention of spills on water from tankers and bulk cargo ships could be enhanced by installation of extensive physical equipment upon these ships. This equipment could include such items as double hulls for tankers, segregated ballast compartments, improved steering equipment or advanced radar systems. Most vessels do not have such equipment and are not now required to install it. The Federal government has the authority to regulate shipping and set tanker designs and construction requirements. The inclusion of modern technology into these requirements has been very slow and subject to other considerations of commerce, foreign relations and national interests.

This involvement by the Federal government precludes any local or State level action which can directly address commercial vessel design, construction, or operation.

Spill prevention from shoreside facilities can be readily accomplished through the application of available technology. Simple devices such as containment dikes around storage facilities, pressure regulators and bypass pipelines, to name only a few, can provide a high degree of spill prevention and containment. Some shoreside facilities are regulated by EPA or Caost Guard, others by State agencies, and some may be regulated on both levels.

Spill Identification

A weak link in the oil and chemical spill management system is the technology for identification of a spill event and subsequently, the identification of the spilled substance.

The early warning system for spill occurrence depends upon human observation. Shoreside facilities may have sensing systems that alert personnel about a leak or spill that is occurring. However, once a spill from a vessel or shoreside facility is in the water, there is no effective, automative detection mechanism. The Oceanic Society and California Department of Fish and Game (DFG) use irregularly scheduled air patrols to detect oil spills, and the Coast Guard has daily helicopter flights over the Bay, but many "nonvisible" chemicals may escape their detection.

An automatic monitoring system of permanently moored samplers and sensors would require a very large number of installations to adequately cover the Bay area. Such equipment that could automatically detect a large variety of hazardous chemicals, at a remote location, day after day, year after year, does not exist. The closest laboratory instrument that could perform such a function would be something similar to a gas chromatograph that requires extensive sample preparation, frequent servicing and calibration, and is very costly to install. Such problems mean that at this time, spill detection depends upon human observation.

Spill identification is another area where technology provides an obstacle to rapid corrective action. In the case of oil spills, the physical characteristics of oils are such that identification is easy and rapid. Spills of non-floating and possibly soluble chemicals provide greater problems. Long and extensive laboratory analysis is required to identify a mystery spill. By the time a sample of water can be collected, sent to a laboratory, analysed and the results obtained, much damage could be done and a spilled chemical may have travelled out of a controllable area. The great variety of chemicals being produced in today's laboratories and factories necessitates a complex analytical procedure for each sample.

Spill Containment and Cleanup

Spill containment and cleanup procedures and equipment are well defined and highly effective for oil spills. The U.S. Coast Guard, the oil and chemical industry, and spill cleanup contractors have gathered experience and equipment well suited for oil spill control.

Containment and cleanup of other hazardous chemicals in water is less well developed. A chemical spill in a small stream or waterway can be contained by blocking off the entire waterway and pumping out the chemical. A spill into a large body of water, or even a portion of a large body has often been reported or identified after the spill has dissipated, leaving cleanup agencies thinking that nothing could be done or hoping that dilution was adequate. Technical problems associated with the containment of water soluble or heavier-than-water chemicals have added to the feeling that little could be done.

The special study uncovered mixed capabilities to neutralize-in-place various chemicals or enhance dissipation in the larger water bodies of the San Francisco Bay or the Sacramento River Delta. However, there are areas such as harbors, sloughs and confined bays where such

chemicals could be temporarily contained. Neutralization of these chemicals by chemical precipitation, acid-base neutralization, chemical dispersants of chemical oxidation might be of value under some circumstances for some spilled chemicals. The U.S. Coast Guard claims that under circumstances of spills to water bodies with limited extent, the Coast Guard, or their contractors, employ all practical means to minimize damage from a spill. Discussion with DFG personnel indicated that they would not attempt chemical neutralization because it would be difficult to accomplish and could interfere with criminal prosecution of the spills.

REGULATION AND MANAGEMENT

Spill Prevention

The Spill Prevention and Control Countermeasures (SPCC) plans are required by the EPA of all owners or operators of non-transportation-related onshore and offshore facilities which could discharge harmful quantities of oil into United States waters. Features of these plans include containment and diversion facilities to prevent spilled oil from reaching surface waters, an oil spill contingency plan and commitments of manpower and materials to control and remove spilled oils. Regulations do not require a review of these plans by EPA until after a spill. This is only a minor fault with the system because each facility must make the plan available to EPA at the plant site and total adequacy of a plan is often difficult to assess until after a trial spill has occurred.

Potentially more serious is the fact that these plans do not cover chemical spills other than oil. The consequences of spilled chemicals can be severe and would appear to justifiably be of equal concern to the EPA. Fortunately, the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) requires, as part of the NPDES permit issued to discrete dischargers, that the discharger file a chemical (including oil) spill contingency plan with the RWQCB. Additionally, the DFG requires spill prevention measures for hazardous chemicals that could end up in State waters. U.S. Coast Guard regulations apply to transportation-related facilities. Thus the mechanism exists for planning spill prevention and control. It is uncertain at this time whether industrial facilities discharging to municipal sewer systems, and not subject to NPDES permit requirements, pose a significant hazard to Bay area waters.

The profusion of agencies involved in oil and chemical spill prevention and control, each with some areas of independent jurisdiction and some areas of overlapping jurisdiction, creates a difficult setting under which to evaluate and plan comprehensive spill programs. There appears to be a lack of a Bay area regional coordination of the efforts of these agencies and the development of common policies and objectives. This is evidenced in a number of ways:

1. The RWQCB, charged with overall responsibility for protection of Bay area waters, does not have records of all spills reported in the area, and its records are difficult to retrieve.

2. The local DFG office in Yountville has the most complete set of spill reports, particularly with regard to spill cleanup procedures. However DFG does not have a mechanism to evaluate the effectiveness of the procedures and relate the evaluation to the other agencies.

3. The local DFG office apparently has a policy not to attempt neutralization of hazardous chemical spills into larger water bodies (other than small channels where DFG can dam the entire channel) because it interferes with the prosecution of a spiller. Is this objective of a "clearly traceable" fish kill compatible with the general desire to minimize chemical spill damage?

4. The EPA's inspection of industrial facilities for their Spill Prevention and Control Countermeasure plans determines a) the existence of such plans, and b) the state of readiness of a facility to deal with a spill. Yet the results of these inspections are not forwarded to the other interested agencies, particularly DFG, which manages the State Oil Spill Contingency Plan, or the Coast Guard, which may have to clean up a spill in the Bay, regardless of its origin.

5. The U.S. Coast Guard, which by law must be informed of any oil or hazardous chemical spills into the Bay, has no record of any hazardous chemical spills in their Pollution Incident Reporting System for the years 1973 to 1975. Yet, a look at DFG records indicates a high percentage of hazardous or toxic chemical spills. (See Appendix B)

Vessel Traffic System

The Coast Guard's vessel traffic system, which closely monitors the movement of large commercial vessles in the Bay area, is a voluntary system for almost all vessels. Ships with particularly dangerous cargoes, such as explosives, are directly regulated and must use escort boats during daylight hours, along with other precautions, to prevent accidents. The Coast Guard has estimated a 99 percent voluntary compliance with their vessel traffic system. Pending regulations would make the system mandatory for all vessels in the San Francisco Bay. The regulation approval process will take approximately one year to complete.

A possible problem with the vessel traffic system is its extent. The high-resolution radar system, centered on Yerba Buena Island, is the major component of the system. This radar does not extend to much of San Pablo Bay and Carquinez Straits. This area is frequented by oil tankers, cargo ships, and munitions ships destined for Port Chicago. Admittedly, bridge-to-bridge radio-telephone communication is part of the vessel traffic system extending to the city of Pittsburg. However, a radar station covering the Carquinez Straits and San Pablo Bay could add another layer of accident prevention.

Federal Preemption

Federal laws and regulations, including Coast Guard regulations, preempt state and local laws on commercial vessel operation and construction. Thus a state wishing to impose more stringent requirements on vessels within its own waters, cannot. This also applies to fuel transfer terminals. State and local control can be exerted upon land-based industrial facilities that may spill oil or chemicals. EPA's SPCC plan system does not preclude more stringent local control of possible oil dischargers. The resulting complexity of regulations is obvious in the special study report.

Local Contingency Plans

With regard to oil or chemical spills on water, the special studies report identified problems of time delays in the sequential notification of proper state agencies about spill events. The State Office of Emergency Services is the central clearinghouse for notification of proper State agencies but often the Coast Guard is the notified agency. The example of the Bethlehem shipyard oil spill cited in the special study report indicates that both agencies were slow in their notification procedures.

In the event of unidentified chemical spill, the first signs of such a spill may be secondary. As an example, a fish kill may be the result of a non-reported chemcial spill. The agency responsible for investigating such a phenomenon is the Department of Fish and Game. Information from DFG concerning their response time, spill investigation and cleanup on previous chemical spills is still forthcoming at the time of preparation of this report.

The following conclusions are preliminary and are based upon staff interpretations of conversation held with DFG personnel. DFG attempts to investigate all chemical spills reported to their office, including vague calls of mysterious, foamy or colored substances but due to limited manpower must pass up reports that do not sound serious. The DFG warden arriving on the scene, after what may be several hours, tries to assess the nature of the spill. His tools are visual observation and a simple pH kit, which establishes whether water is caustic or acidic. A sample of liquid is taken for later analysis at the DFG laboratory in Sacramento. It could take days to ship a sample and receive an analytical report. If a spill is obviously or know to be hazardous or toxic and can be confined in a stream bed, the warden may initiate action to dam the stream and pump out the chemical. Otherwise, his efforts are directed toward locating the source of the spill for possible criminal and civil prosecution.

It appears that the entire tone of DFG's program for handling non-oil, chemical spills is directed toward apprehending the spiller then rapidly identifying the nature of the problem and minimizing the damage.

If a chemical spill can be identified or appears to be large, DFG will call in the Coast Guard or private contractors who may take appropriate cleanup action.

Oil and Chemical Spills on Roadways

Oil and chemical spills on State roads are usually contained and identified by State Department of Transportation (Caltrans) personnel. Caltrans has had since 1973 a hazardous spill program which includes training courses and refresher courses for their own personnel and training courses for outside agencies. Cleanup is generally by the manufacturer or CHEMTREC (Chemical Transportation Emergency Center). For spills occurring with cities and off state highways the local fire department is usually called. The special study's report has concluded that while most fire departments are prepared to respond to spills, others, due to lack of specific training or equipment, are not. In the past, the usual consequence of this lack of training was that spilled chemicals would be washed down the nearest storm sewer to enter a sewage treatment plant or the Bay instead of being contained for proper cleanup. Some of the fire departments contacted during the special study did not even know of the availability of the CHEMTREC hotline for chemical spill information. However, it must be repeated that most fire departments are aware of CHEMTREC and claim preparedness to handle chemical spills.

POSSIBLE SOLUTIONS

Most of the problem areas identified in the special study report are amenable to corrective action. The possible solutions can be grouped under three major policy statements:

1. Improve coordination and performance of local, State and Federal agencies in preventing and dealing with oil and chemical spills in the Bay Area.

2. Reduce risk of oil tanker accidents.

3. Support State and Federal legislation designed to minimize risk of spills.

These policy statements provide the basis for a broad range of mitigation measures intended to reduce oil and chemical spill occurrence and damage. With the exception of the fifth possible action, those actions listed below are not capital intensive and could be instituted with a minimum irreversible commitment of resources. The following is a brief summary of the possible solutions being considered for detailed evaluation:

Improve coordination and performance;

1. Establish Bay Area agency to coordinate activities of Federal, State and local agencies.

2. Monitor activities and performance of agencies in Bay area.

3. Report annually to Governor, EPA Administrator, and Secretary of Transportation.

4. Improve local roadway spill containment and cleanup procedures.

Reduce risk of tanker accidents;

5. Improve vessel traffic system in San Pablo Bay and Carquinez Straits,

Support Legislation;

6. Support State legislation proposing increases in liability of spillers.

7. Support Federal legislation proposing increases in liability of spillers.

8. Support Federal regulations proposing improvements in requirements for navigational aids and tanker construction.

There were several problem areas for which no solutions, implementable under the EMP, were apparent. Among these were:

1. Installation of spill prevention technology on vessels due to Federal preemption of local activities.

2. The lack of a dependable, reliable, and economical, automatic water quality monitoring system to provide early warning for a broad variety of oil and chemical spills in water.

3. The lack of simple, rapid, and portable analytical tools to identify a broad variety of spilled substances in water.

IMPROVE COORDINATION AND PERFORMANCE

The policy stated in full is to improve coordination and performance of local, State and Federal agencies in preventing and dealing with oil and chemical spills in the Bay Area. It is suggested that an agency, whose primary concern is protection of Bay area waters, would be selected. This agency would provide coordination of all spill activities of all agencies in the Bay Area. This step is necessary because of the complexity of regulations and division of responsibilities for spill prevention and control. The agency would provide coordination for facility inspections, contingency planning, spill handling, policy development and public information programs. It is expected that the resulting exchange of information among agencies will result in increased awareness of problems and possible solutions. Conceivably, there may result a more efficient use of limited personnel for facility inspections and more efficient interagency response to spills. Common goals and objectives will strengthen the dilute efforts of several agencies each dealing with only portions of the total problem. Agencies peripherally involved in spill management such as the California Highway Patrol which inspects labeling of hazardous chemical containers could, through better understanding, increase the effectiveness of their programs.

The coordinating agency would monitor the performance and effectiveness of all agencies in dealing with spills. Monitored agencies would include the U.S. Coast Guard, DFG, EPA, RWQCB, California Office of Emergency Services, California Highway Patrol, the Department of Transportation, local fire departments and spill cleanup contractors. This monitoring could serve two basic purposes. The first would be a feedback mechanism to each agency on their procedures for spill handling. The second, and more important purpose, would be to improve interagency cooperation and planning. Monitoring would look at items such as frequency and redundancy of inspections, spill notification procedures, spill response time, identification of pollutants, cleanup effectiveness and problem areas. The specific monitoring program should be developed by the selected coordinating agency.

The coordinating agency would report on the results of the coordination program and monitoring. The report would be submitted to the Governor, EPA Administrator, Secretary of Transportation and officials of local spill response agencies. The coordinating agency would have no enforcement powers. It could bring about changes by making recommendations in its annual report and by providing a technical forum for the other agencies. The good will and intentions of all agencies dealing with oil and chemical spills are recognized. It is believed that by providing an interchange of technical, planning and regulatory information, the coordinating agency can bring about the highest levels of protection for Bay Area waters.

Certain problem areas have been identified in the special study report. Some, such as the quagmire of regulations and agencies are real and certain while others, dealing with the effectiveness of chemical spill handling procedures are less certain. Only a coordinated monitoring effort of the extensiveness proposed in this memorandum can accurately identify and resolved all problems.

The first agency called to the scene of a chemical spill on a local roadway is usually the local fire department. Each individual fire department should prepare contingency plans that could deal with the great variety and complexity of hazardous chemicals. These plans would include training of personnel, purchase of appropriate equipment and development of procedures for containment, and if necessary, cleanup of spilled substances. It is recognized that many fire departments already have developed the capability to deal with chemical spills. However, the special studies' report indicates that some fire departments are prepared to do no more than wash all spilled non-explosive chemicals directly into the nearest sewer.

REDUCE RISK OF TANKER ACCIDENTS

The U.S. Coast Guard's vessel traffic system does not include high resolution radar coverage of San Pablo Bay or the Carquinez Straits. The Coast Guard reported that a study had been made that concluded an ancillary radar substation covering this area was not justified. The study report has not been received by ABAG staff and the validity of the conclusions are unverified by staff. Current information indicates that the additional radar substations would provide enhanced protection to an ecologically sensitive area frequented by oil tankers.

SUPPORT LEGISLATION DESIGNED TO MINIMIZE RISK OF SPILLS

State and Federal legislation have been proposed to increase the financial liability of persons or companies causing spills that damage the environment. This provides direct economic incentives to manufacturers, shippers, and users of oil and hazardous chemicals to maximize their spill prevention activities. It removes from the general public the cost burdens associated with spills over which the public has no control or for which, no liability. The Environmental Mangement Plan should support the position that the entity held responsible for a spill should be held liable for all damage resulting from that spill. At this time legislation directed toward that goal includes the proposed Federal Comprehensive Oil Pollution Liability and Compensation Act and State Senate Bills Nos. 536 and 841, copies of which are provided in Appendix A. Senator Warren Magnusen's bill S.682 would enact into Federal law the intended provisions and regulations on construction and safety standards of the Ports and Waterways Safety Act that do not appear in Coast Guard regulations.

U.S. COAST GUARD POSITION

In as much as the U.S. Coast Guard has primary responsibility for oil spill prevention and cleanup in offshore water, their comments have been included in Appendix C. Additional information is provided in Appendix D, received from the State Interagency Tanker Task Force. Of particular note is the measure proposed by California Assemblyman Gary Hart.

APPENDIX A

PENDING LEGISLATION AFFECTING SPILLS

SENATE BILL No. 536

Introduced by Senator Rains

March 14, 1977

An act to repeal Section 293 of, and to repeal Chapter 4 (commencing with Section 151) of Division 1.5 of, the Harbors and Navigation Code, to add Division 3.5 (commencing with Section 3800) to the Public Resources Code, and to amend Section 13350 of the Water Code, relating to pollution.

LEGISLATIVE COUNSEL'S DIGEST

SB 536, as introduced, Rains. Petroleum pollutant discharges: compensation.

Present law makes it a misdemeanor to discharge oil from vessels into navigable waters of the state. Under current law, owners and operators of vessels engaged in commercial transportation of petroleum or fuel oil are absolutely liable, except as specified, for damage and costs of cleanup caused by discharge or leakage of such petroleum or oil into or upon the navigable waters of the state. Existing statutes also authorize daily civil penalties against any person who causes or permits the deposit of oil or residuary petroleum products in or on any waters of the state, except as otherwise permitted by discharge permits.

The bill would prohibit, except as permitted by regulation or law, the discharge of pollutants, as defined, into or upon state's waters or affecting state waters, provides for civil liability and penalties for such discharges, and requires notice of discharges of approximately 10 gallons or more of oil pollutants. The bill would provide for penalties of fine, imprisonment, or both in certain prescribed circumstances.

The bill would establish, in the Resources Agency, the Oil Spill Compensation Board, and prescribe its membership, power, and duties.

It would establish the California Oil Pollution Compensation Trust Fund, administered by the board, to provide for costs and expenses for administration, for costs involved in the cleanup of discharges of pollutants, for costs and expenses of the cleanup, rehabilitation, and replacement of natural resources damaged by the discharges of pollutants, and for designated research in connection with pollutants discharge.

The bill would require that all civil penalties, operation fees, and penalties collected from discharges be deposited to the fund.

This bill would require payment of operation fees, until the fund reached its maximum limit of $35,000,000, at designated amount per barrel of pollutants onloaded or offloaded between a facility and vessel, between vessels, and between facilites, which terms would be defined by the bill.

The bill would provide that it would not preempt local regulation except in cases of direct conflict, but prohibits local governments from establishing any similar program of licensing and fees for the accomplishment of the purposes of this bill.

The bill would provide for arbitration of damage claims, as specified, without prohibiting court action.

The bill would also provide that neither appropriation is made nor obligation created for the reimbursement of any local agency for any costs incurred by it pursuant to the bill.

Vote: majority. Appropriation: no. Fiscal committee: yes. State-mandated local program: yes.

The people of the State of California do enact as follows:

SECTION 1. Chapter 4 (commencing with Section 151) of Division 1.5 of the Harbors and Navigation Code is repealed.

SEC. 2. Section 293 of the Harbors and Navigation Code is repealed.

293. ~~Where damage arises out of, or is caused directly and proximately by, the acts of an owner or operator, without the interposition of any external or independent agency which was not or could not be foreseen, any owner or operator of any vessel engaged in the~~

~~commercial transportation of petroleum or fuel oil shall be absolutely liable without regard to fault for any property damage incurred by the state or by any county, city or district, or by any person, within the state, and for any damage or injury to the natural resources of the state, including, but not limited to, marine and wildlife resources, caused by the discharge or leakage of petroleum or fuel oil from such vessel into or upon the navigable waters of the state.~~

~~As used in this section, the term "owner or operator" means any person owning or operating, or chartering by demise, such vessel, the term "person" means an individual, firm, corporation, association or partnership, and the term "navigable waters of the state" means all portions of the sea within the territorial jurisdiction of the state and all inland waters navigable in fact.~~

~~This section shall be known and may be cited as the Miller Anti-Pollution Act of 1971.~~

SEC. 3. Division 3.5 (commencing with Section 3800) is added to the Public Resources Code, to read:

DIVISION 3.5. CALIFORNIA OIL SPILL COMPENSATION ACT

Chapter 1. Title and Policy

3800. This division shall be known and may be cited as the California Oil Spill Compensation Act.

3801. The Legislature finds and declares that spills and discharges of pollutants resulting from the production, processing, transfer, transportation, storage, and use of pollutants on or near state waters pose threats of great harm and damage to the wildlife and environment of the state, to the owners and users of property, to public and private recreation, to the citizens of the state, to other interests deriving livelihood from marine-related activities, and to the beauty of this state.

3802. The Legislature further finds and declares that the preservation of the environment and the other private and public uses specified in Section 3801 from

damage by pollutant discharges is of grave public interest and concern to the state in promoting its general welfare, preventing disease, promoting health, and providing for the public safety, and that the interest of the state in such preservation outweighs any burdens of strict liability imposed by the Legislature upon persons engaged in transferring, producing, or storing pollutants or engaged in related activities.

3803. The Legislature further finds and declares that any transfer of pollutants between vessels, between vessels and facilities, and between facilities, and any exploration or drilling for, and the production of, oil, gas, or any other petroleum hydrocarbons on or near state waters is an ultrahazardous undertaking.

3804. The Legislature further declares that this division shall be liberally construed to protect the general welfare and public health and safety of the state and its inhabitants and to support and complement pertinent federal laws, particularly the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), relating to the natural contingency plan for removal of oil and other pollutants.

3805. The Legislature in enacting this division vests the Oil Spill Compensation Board with the following responsibilities:

(a) To manage the California Oil Pollution Compensation Trust Fund and to provide procedures whereby the state or persons suffering damage from discharges of pollutants may be promptly made whole.

(b) To enforce the civil penalty provisions of this division.

Chapter 2. Definitions

3810. Unless the context otherwise requires, the definitions in this chapter govern the construction of this division.

3811. "Barrel" means 42 U.S. gallons at 60 degrees Fahrenheit.

3812. "Board" means the Oil Spill Compensation

Board.

3813. "Citizen" or "domiciliary" includes any person who is a citizen or domiciliary of this state, any foreign corporation having substantial business contacts in this state, or any person who is subject to service of process in this state.

3814. "Discharge" includes, but is not limited to, any intentional or unintentional spilling, leaking, seeping, pouring, emitting, emptying, pumping, or dumping of oil or other pollutants.

3815. "Facility" means a structure or group of structures, other than a vessel or vessels, used for the purpose of transporting, producing, processing, storing, transferring, or handling pollutants.

3816. "Fund" means the California Oil Pollution Compensation Trust Fund established under Section 3850.

3817. "Guarantor" means the person, other than the owner or operator, who provides evidence of financial responsibility for an owner or operator.

3818. "Owner" means any person holding title to, or, in the absence of title, any other indicia of ownership of a vessel or facility.

3819. "Operator" means either of the following:

(a) In the case of a vessel, a charterer by demise or any other person, except the owner, who is responsible for the operation, manning, victualing, and supplying of the vessel.

(b) In the case of a facility, any person, except the owner, responsible for the operation of the facility by agreement with the owner.

3820. "Person" includes any individual, association, partnership, corporation, business trust, or governmental entity.

3821. "Pollutant" or "pollutants" means oil of any kind and in any form, including, but not limited to, petroleum products or their byproducts, gasoline, fuel oil, sludge, oil refuse, oil mixed with wastes, or crude oil.

3822. "State's waters" or "waters of the state" means any water, surface or underground, including saline

waters, within the boundaries of this state.

3823. "Terminal" means a permanently situated facility, located within this state, which is not owned by any agency of the federal government or the State of California, that ships or receives pollutants in bulk directly from any vessel, offshore production facility, or offshore port facility, on an average of 5,000 barrels of pollutants per day, as calculated for any 12-month period.

3824. "Transfer" or "transferred" includes onloading or offloading between a facility and a vessel, between vessels, and between facilities.

3825. "Vessel" includes every description of watercraft or other contrivance used, or capable of being used, as a means of transportation on water, whether self-propelled or otherwise, including any barge or tug, except any vessel under 75 feet at the waterline, which is never involved in any transportation of pollutants except for those pollutants necessary to power the vessel.

Chapter 3. General Powers and Regulations

3830. (a) There is in the Resources Agency an Oil Spill Compensation Board, consisting of the Secretary of the Resources Agency, the chairperson of the State Water Resources Control Board, the executive officer of the State Lands Commission, the Director of Fish and Game, and the Director of the Office of Planning and Research. The board shall select a chairperson from among its members. Action may be taken by a majority vote of the board with no less than three members present.

(b) The powers and duties conferred by this division shall be exercised by the board. The board may delegate such powers and duties to the State Water Resources Control Board, the Department of Fish and Game, the State Lands Commission, or any other state agency, department, or commission. In addition, the board may request any state agency, department, or commission for assistance of any type, including consultative services or technical advice. Upon such request, such agency, department, or commission shall promptly and fully

cooperate with the board. Compensation for services rendered shall be made pursuant to Section 3853.

3831. The board shall adopt, and may from time to time amend, regulations for the administration of this division. Such regulations shall be adopted in accordance with the provision of Chapter 4.5 (commencing with Section 11371), Part 1, Division 3, Title 2 of the Government Code.

3832. The board shall keep an accurate record of the costs and expenses incurred by the state or any state agency, department, or commission in carrying out the provisions of this division and in responding to any pollutant discharge. Additionally, the board shall annually report to the Legislature all disbursements from the fund. The board shall annually submit a report to the Legislature containing specific recommendations relating to amendments of this division in furtherance of protection of the environment and compensation for damage from discharges.

3833. The board may bring an action on behalf of the state to enforce the liabilities and penalties imposed by, or made pursuant to, this division. The Attorney General shall represent the board in any such proceeding.

Chapter 4. Discharge Prohibitions and Imposition of Civil Penalties

3840. The discharge of any pollutant into or upon state's waters, either directly or indirectly, or into or upon waters outside the waters of the state to the extent to which it affects the waters of the state and which is caused by a citizen or domiciliary of the state, is prohibited, except to the extent otherwise authorized by law.

3841. Any person who violates any provision of Section 3840 shall be strictly liable civilly in an amount of not less than one hundred dollars ($100) nor more than fifty thousand dollars ($50,000). Such civil penalty shall be determined by an administrative hearing officer, qualified under Section 11502 of the Government Code

and in accordance with the provisions of the Administrative Procedure Act (commencing with Section 11500 of the Government Code).

(b) Each 24-hour period during any portion of which the violation occurs shall constitute a separate violation. Violations shall include, but not be limited to, the presence of pollutants in or on state waters. In addition, the administrative hearing officer may determine, after an examination of the facts, that multiple violations have occurred in a given 24-hour period.

(c) In determining the amount of such civil penalties, the administrative hearing officer shall take into consideration all relevant circumstances, including, but not limited to the following:

(1) The location of the occurrence.

(2) The duration of the pollution.

(3) The extent of damage caused by the pollutants.

(d) Penalties assessed pursuant to this section shall be in addition to any other civil or criminal penalties assessed by the state. Such penalties shall have no effect upon the liabilities set forth in Section 3855.

3842. In the event any person fails to pay to the state forthwith the penalty assessed under Sections 3841 and 3855, the Attorney General, upon request by the board, shall bring an action in the county or counties in which the violation or violations of this division occurred to collect any civil penalties. The court shall levy the amount determined by the administrative hearing officer, unless such determination is arbitrary, capricious, or clearly unsubstantiated by the weight of the evidence.

Chapter 5. Orders to Suspend or Remove

3845. (a) The board may issue an order to suspend pollutant transfer operations, to remove any vessel from state waters, or to take any action the board deems necessary, if the board finds that immediate action is required to prevent the discharge or threat of discharge of pollutants.

(b) An order of suspension or removal may be effective

immediately.

(c) An order of suspension or removal shall include a statement of each condition and circumstances requiring immediate action to prevent the discharge or threat of discharge of pollutants.

(d) Whenever the board issues such an order of suspension or removal, the Attorney General, upon request of the board, shall petition the superior court to enforce such order of suspension or removal. The court shall have jurisdiction to grant the necessary prohibitory or mandatory relief by issuance of a temporary restraining order, preliminary injunction, or a permanent injunction. In any such civil action, it shall not be necessary to allege or prove, at any stage of the proceeding, that irreparable damage will occur or that the remedy of law is inadequate, and the temporary restraining order, preliminary injunction, or permanent injunction shall be issued without such allegations and without such proof.

Chapter 6. California Oil Pollution Compensation Trust Fund

3850. There is in the State Treasury the California Oil Pollution Compensation Trust Fund. The amount of the fund shall be limited to the sum of thirty-five million dollars ($35,000,000). All moneys in the fund are available to the board, when appropriated by the Legislature, for expenditure in accordance with the provisions of this division. All civil penalties, operation fees, or other amounts collected or recovered pursuant to the provisions of this division shall be deposited in the fund.

3851. Moneys in the fund that have not been appropriated or are not currently needed to meet the obligations of the board in the exercise of the board's responsibilities under this division may be invested in such manner as is provided by law. All the interest or other increment realized upon such investment shall be credited to the fund.

3852. (a) The board shall levy and collect from the

owner of each terminal an operation fee on the transfer of all pollutants to or from such facility.

(b) The operation fee on the transfer of pollutants shall be for the privilege of operating such a terminal and the handling of all pollutants covered by this division. The operation fee provided in this section shall be collected monthly by the board on the basis of records certified by the board and shall be credited to, and deposited in, the fund; provided, however, that for the purposes of this section, the operation fee on each barrel of the pollutant shall be imposed only once at the first transfer of the pollutant that occurs within the boundaries of the state. Such operation fee shall be in addition to all taxes or other fees imposed upon, or paid by, the owner of such terminal.

(c) The operation fee shall be three cents ($0.03) per barrel of pollutant transferred; provided, however, that with respect to any oil that has been assessed the five-cent ($0.05) per barrel fee pursuant to the Trans-Alaska Oil Pipeline Act (Public Law 93-153), the operation fee required by this division shall be one and one-half cents ($0.015) per barrel. The fee shall be discontinued at such times as the balance of the fund equals or exceeds thirty-five million dollars ($35,000,000) and may be reimposed, as deemed necessary by the board, to meet the obligations prescribed by this division. The board shall reimpose the operation fee when the amount in the fund is less than thirty-two million dollars ($32,000,000). The board shall prescribe all regulations necessary for the collection of the operation fee.

3853. Moneys in the fund shall be disbursed for the following purposes, and no others:

(a) Administrative expenses, personnel expenses, and equipment costs of the board and any other state agency, department, or commission which is designated by the board as being related to the enforcement of this division.

(b) Costs involved in the cleanup of discharges of pollutants, whether performed or authorized by the board.

(c) Costs and expenses of the cleanup, rehabilitation,

and replacement of fauna and flora and all other natural resources damaged by the discharge of pollutants, whether performed or authorized by the board.

(d) Research into the methods for containing and removing pollutants and on the effects of pollutants on the environment. However, amounts expended pursuant to this subdivision shall not exceed the amount of five hundred thousand dollars ($500,000) in any one calendar year.

(e) Costs and expenses for the employment of neutral arbitrators, as authorized by Chapter 10 (commencing with Section 3880) of this division.

(f) Claims payable pursuant to Chapter 7 (commencing with Section 3860) and Chapter 9 (commencing with Section 3875) of this division.

3854. Except as limited by Section 3860, the board shall recover for reimbursement of the fund, from the owner or operator of any facility or vessel determined to be the source of any discharge or from the federal government, jointly and severally, all sums owed to, or expended from, the fund resulting from such discharge. If the requests for reimbursement to the fund in proper amount are not paid within 30 days of demand, the Attorney General shall pursue the collection of the reimbursement from the liable party.

3855. Any person who fails to pay fees as required pursuant to Section 3852 shall be liable for a civil penalty not to exceed ten thousand dollars ($10,000). Such penalty shall be determined by an administrative hearing officer, qualified under Section 11502 of the Government Code and in accordance with the provisions of the Administrative Procedure Act (commencing with Section 11500 of the Government Code).

Such penalty shall be in addition to the fees required to be collected or paid and the interest on such fees. Upon the failure of any person so liable to pay any penalty, fee, and interest upon demand, the Attorney General shall, at the request of the board, bring an action against that person for such an amount.

Chapter 7. Liability

3860. (a) Where pollutants are discharged from a vessel, the owner and operator of such vessel shall be strictly liable, jointly and severably, without regard to fault, for all costs of containment, abatement, cleanup, and resulting damage in an amount not to exceed one hundred fifty dollars ($150) per gross registered ton of such vessel.

(b) Where pollutants are discharged from a facility, the owner and operator of such facility shall be strictly liable, without regard to fault, for all costs of containment, abatement, cleanup, and resulting damage.

(c) If such discharge from a vessel or facility was willful or the result of gross negligence or willful misconduct, or the result of noncompliance with applicable safety or construction standards by the owner or operator or any of his agents, such owner and operator shall be jointly and severally liable, without limit, for all costs of containment, abatement, cleanup, and resulting damages.

(d) Liability for costs and damages resulting from a discharge of a pollutant shall not be imposed on any person pursuant to subdivision (a) or (b) of this section, if the owner or operator establishes that such discharge was caused solely by an act of war. Liability with respect to damages claimed by a damaged party shall not be imposed under subdivision (a) or (b) of this section, if the owner or operator establishes that such discharge was caused solely by the negligence or intentional act of such damaged party.

3861. Any agreement entered into after January 1, 1978, to "hold harmless" any person or any federal, state, or local governmental entity from liability for the occurrence of a discharge prohibited by this division, even if agreed to by such a person or a federal, state, or local governmental entity, shall be deemed contrary to public policy, void, and of no effect, and is hereby prohibited.

3862. Whenever the owner or operator of a vessel fails to satisfy any claim by the board for reimbursement to

the fund of any sums expended from the fund for containment, abatement, cleanup, or damages in accordance with the provisions of this division, the board may seek and recover such reimbursement from any affiliate of the owner or operator of the vessel when the board can prove, in a court of competent jurisdiction, that the discharge of any pollutant was caused by the unseaworthiness of the vessel or the negligence of the vessel's owner or operator.

3863. Whenever the board determines that the negligent or willful act or omission of a third party, wholly or substantially, caused the discharge of pollutants, such third party may not file any claim against the fund for cost of containment, abatement, or cleanup or for damages arising from such discharge. The provisions of this division shall not in any way affect or limit any right that a third party may have against the owner or operator of a vessel or facility or licensee.

3864. The provisions of this division shall not in any way affect or limit any rights that the fund or any owner, operator, or a guarantor of a vessel or facility may have against any third party whose acts may have caused or contributed to a discharge of pollutants.

3865. In addition to the damages for which claims may be asserted under Section 3875 and 3876, and without regard to the limitation of liability provided in Section 3860, the owner, operator, or guarantor shall be liable to the claimant for interest on the amount paid in satisfaction of the claim for the period from the date upon which the claim was presented to such person to the date upon which the claimant is paid, inclusive, less the period, if any, from the date upon which the owner, operator, or guarantor shall offer to the claimant an amount equal to or greater than that finally paid in satisfaction of the claim to the date upon which the claimant shall accept that amount, inclusive. However, if the owner, operator, or guarantor shall offer to the claimant within 60 days of the date upon which the claim was presented, or of the date upon which the advertising was commenced pursuant to Section 3872, whichever is

later, an amount equal to or greater than that finally paid in satisfaction of the claim, the owner, operator, or guarantor shall be liable for the interest provided in this section only from the date such offer was accepted by the claimant to the date upon which payment is made to the claimant, inclusive. The interest provided in this section shall be calculated at the existing commercial interest rate.

Chapter 8. Notification, Designation and Advertisement

3870. The person in charge of a vessel or facility, as soon as he has knowledge of the discharge of pollutants, in the quantity of 10 gallons or more, into or upon state waters, shall give immediate notice of such discharge to the board.

3871. Any person subject to Section 3870 who fails to notify immediately the board of such discharge shall, upon conviction, be fined not more than ten thousand dollars ($10,000), or imprisoned in the county jail for not more than one year, or punished by both such fine and imprisonment.

3872. (a) When the board receives information, pursuant to Section 3870 or otherwise, of a pollutant discharge into or upon the state's waters, the board shall, where possible, designate the source or sources of the pollutant and shall immediately notify the owner, operator, and guarantor of such source of that designation.

(b) When a source designated under subdivision (a) of this section is a vessel or a facility, and the owner, operator, or guarantor fails to inform the board, within five days after receiving notification of the designation of his denial of such designation, such owner, operator, or guarantor shall advertise the designation and the procedures by which claims may be presented to him. If advertisement is not otherwise made in accordance with this subdivision, the board shall, at the expense of the owner, operator, or guarantor involved, advertise the

designation and the procedures by which claims may be presented to that owner, operator, or guarantor.

(c) The board shall advertise the procedures by which claims may be presented to the fund in either one of the following cases:

(1) If the owner, operator, and guarantor all deny a designation in accordance with subdivision (b) of this section.

(2) If the board is unable to designate the source or sources of the discharge under subdivision (a) of this section.

(d) The advertisement under subdivision (b) of this section shall commence no later than 15 days from the date of the designation made thereunder and shall continue for a period of no less than 30 days.

Chapter 9. Damage Claims

3875. Claims for damages, arising out of, or resulting from, a pollutant discharge, may be asserted as follows:

(a) Unless compensated pursuant to subdivision (c) of this section, the value of any loss, including loss of use, at the time of loss, with respect to real or personal property damaged or destroyed as a result of the discharge of pollutants.

(b) The cost of cleanup, containment, and abatement of pollutants performed or authorized by the board.

(c) The cost of restoring or repairing real or personal property damaged by the discharge of pollutants and the loss in value of real and personal property after such restoration or repair.

(d) Costs and expenses for rehabilitation of fauna and flora and all other natural resources damaged by pollutants, which rehabilitation or replacement has been authorized or performed by the board.

(e) Loss of income resulting from the loss of real or personal property or natural resources damaged by pollutants during the time when the property is being restored, repaired, or replaced.

(f) Any loss of income or impairment of earning

capacity due to damages to real or personal property, including natural resources, without regard to ownership of such property or resources, that is damaged or destroyed by a discharge of oil, if the claimant derives at least 50 percent of his earnings from activities which utilize the property or natural resources.

(g) In the case of claims filed by the federal government, states, or political subdivisions thereof, in addition to the other damages provided by this subdivision, loss of use by citizens of real property or natural resources owned, managed, held in trust, or otherwise controlled by such governmental units, or for which such governmental unit is primarily responsible; provided, however, that compensation paid to governmental units under this subdivision shall be used only in mitigation of the damages suffered or for acquisition of equivalent property or natural resources.

(h) Costs incurred in mitigation of damages resulting from pollutant discharge.

(i) Death or injuries to persons directly or indirectly caused by a pollutant discharge.

(j) Any other damages which the board may, by regulation, specify in furtherance of the purposes of this division.

3876. The fund shall not be liable for any claims for any discharge of 10 or less gallons of pollutants. The fund shall be liable for all claims proved against the fund as provided in this chapter and for all claims which are based upon discharges assessed by the board to have been more than 10 gallons.

Chapter 10. Claims Settlement and Arbitration

3880. (a) Except as provided in subdivision (b) of this section, all claims shall be presented to the owner, operator or guarantor.

(b) All claims shall be presented to the fund where the board has advertised in accordance with subdivision (c) of Section 3872. For the purpose of processing all such claims, the board shall adopt regulations which establish

uniform procedures and standards for the appraisal and settlement of claims against the fund.

(c) In the case of a claim presented in accordance with subdivision (a) of this section, the claimant may elect to commence an action in court against the owner, operator, or guarantor, or to present the claim to the fund for arbitration as provided in this chapter, which election shall be irrevocable and exclusive, if either of the following occurs:

(1) The person to whom the claim is presented denies all liability for the claim, for any reason.

(2) The claim is not settled by any person by payment to the claimant within 60 days from the date upon which the claim was presented, or the advertising was commenced pursuant to subdivision (b) of Section 3872, whichever is later.

(d) In the case of a claim presented in accordance with subdivision (a) of this section, where full and adequate compensation is unavailable, either because the claim exceeds a limit of liability invoked under Section 3860, or because the owner, operator, or guarantor is financially incapable of meeting his obligations in full, a claim for the amount not compensated may be presented to the fund.

(e) In the case of a claim presented to the fund pursuant to subdivision (b) or (d), of this section, the claimant may submit the claim to arbitration as provided in this chapter, if either of the following occurs:

(1) The fund denies all liability for the claim, for any reason.

(2) The fund does not settle the claim by payment to the claimant within 60 days from the date upon which the claim was presented to the fund or the advertising was commenced pursuant to subdivision (c) of Section 3872, whichever is later.

3881. (a) Whenever the amount of any single claimant's claim which has been submitted to arbitration is ten thousand dollars ($10,000) or less, the arbitration shall be by a single neutral arbitrator. The neutral arbitrator shall be appointed by the board. In all other cases, the arbitration shall be by a panel consisting of

three persons, one to be chosen by the claimants, one to be chosen by the persons determined by the board to have caused the discharge or by the owner or operator of the vessel or facility determined by the board to be the source of the discharge or by the board if the discharge is of unknown origin, and one person chosen by the first two appointed members to serve as a neutral arbitrator. The neutral arbitrator shall serve as chairman. If the two arbitrators fail to agree upon, select, and name the neutral arbitrator within 10 days after their appointments, then the board shall request the American Arbitration Association to utilize its procedures for selection of the neutral arbitrator.

(b) Arbitrators shall be named by their principals within 10 days after the board receives a claim pursuant to subdivision (c) or (e) of Section 3880. If either party shall fail to select an arbitrator within such period, the other party shall request the American Arbitration Association to utilize its procedures for the selection of such arbitrator and the two arbitrators shall proceed to select a neutral arbitrator as provided in this section.

(c) All costs and expenses incurred on account of the employment of a neutral arbitrator shall be payable from the fund. All costs and expenses incurred by the arbitrators appointed respectively by the claimant and the owner or operator of the facility or vessel shall be payable by the respective parties.

(d) No member of the Resources Agency, nor any employee or agent of an owner, operator, guarantor, or claimant, past or present, shall serve as a neutral arbitrator.

(e) Except as otherwise provided in this chapter, the arbitration proceedings shall be conducted in accordance with the provisions of Chapter 3 (commencing with Section 1282) of Part 3 of Title 9 of the Code of Civil Procedure.

(f) All provisions of Section 1283.05 of the Code of Civil Procedure are hereby incorporated into, made a part of, and are applicable to every arbitration proceeding conducted pursuant to this division whenever the

submitted claim is for more than ten thousand dollars ($10,000).

(g) The decision by the neutral arbitrator, if sitting alone, or by the majority of arbitrators shall be in writing and shall contain findings of fact and a determination of the issues presented. Copies of the decision shall be delivered to the parties personally or sent to them by registered mail.

3882. (a) Determinations made by the neutral arbitrator, if sitting alone, or by a majority of the arbitrators shall be final. Confirmation, correction, or vacation of the award shall be made in accordance with the provisions of Chapter 3 (commencing with Section 1285), Part 3, Title 9 of the Code of Civil Procedure, except to the extent otherwise provided. Any action for judicial review shall be filed within 30 days of final determination by the arbitrator or arbitrators.

(b) Not sooner than 30 days after the determination of the arbitrators, nor more than 60 days thereafter, the arbitrators shall certify all claims settled or arbitrated to the board who, in turn, shall certify the amount of the award and the name of the claimant to the State Controller who shall pay the award from the fund, subject to the provision of Section 3883. However, no claim shall be paid while any judicial proceeding for the review of the arbitrators' decision is pending.

3883. In the event the total awards against the fund shall exceed the present balance of amounts appropriated from the fund, the claimants shall have priority over claimants who are subsequently granted awards, in payments from amounts subsequently appropriated from the fund. In the event that the total awards for a specific occurrrence exceed the current balance of amounts appropriated from the fund, the immediate award shall thereafter be paid on a prorated basis, and all claimants paid on a prorated basis shall be paid, as determined by the board, a pro rata share of all moneys subsequently appropriated to the fund until the total amount of the proven damages is paid to the claimant or claimants. However, amounts collected by

the fund from the prosecution of causes of action pursuant to Sections 3890 and 3891 shall be first utilized to satisfy the claims to which such prosecutions relate, to the extent that the judgment therein is theretofore unsatisfied.

3884. Nothing in the division shall require pursuit of any claim against the fund as a condition precedent to any other remedy. Nothing contained in this division shall prohibit any person from bringing a cause of action in a court of competent jurisdicition for all damages resulting from a discharge subject to the provisions of this division. In any such action it shall not be necessary for the plaintiff to plead or prove negligence in any form. The only defenses to such an action shall be those specified in Section 3870. The injured party shall be entitled to recover the costs of the action and reasonable attorneys' fees. If a person elects the remedy of bringing a cause of action in a court of competent jurisdiction rather than submitting a claim for costs and damages to the fund, such person is thereafter foreclosed from submitting any claim to the fund.

Chapter 11. Subrogation and Reimbursement

3890. The fund, upon payment of compensation to any claimant for damages compensable under Sections 3875 and 3878, shall be subrogated to all rights, claims, and causes of action which that claimant has under this division.

3891. (a) It shall be the duty of the board in administering the fund to diligently pursue the reimbursement to the fund of any sum expended from the fund for containment, abatement, cleanup, or damages in accordance with the provisions of this division.

(b) In all claims or actions by the board against any owner, operator, or guarantor, the board shall recover (1) the amount the fund has paid to the claimant, and (2) interest on that amount, which shall be calculated at the existing commercial interest rate, from the date upon

which the request for reimbursement was issued by the board to the owner, operator, or guarantor to the date upon which the board receives such reimbursement, inclusive.

(c) In any action for reimbursement, it shall not be necessary for the board to plead or prove negligence in any form. The board need only plead and prove that the prohibited discharge occurred. The only defenses to such an action shall be those specified in Section 3860.

(d) In any such action the amount of damages shall be proved by the board submitting to the court a written report of the amounts paid or owed from the fund to the claimants. Such written report shall be admissible in evidence and the amounts paid from, or owed by, the fund to the claimants stated therein shall be conclusively presumed to be the amount of damages.

3892. Nothing in this division shall prohibit or limit, in any manner, the board or any person from pursuing recovery for damages caused by the discharge of pollutants against any other federal or state oil spill liability fund to the extent permitted by such fund.

Chapter 12. Financial Responsibility

3900. Each owner or operator of a terminal or vessel, including any barge, shall establish and maintain, under rules and regulations to be prescribed by the board, evidence of financial responsibility based upon the capacity of the facility or tonnage of the ship, the cargo carried, and other relevant factors, as determined by the board. Financial responsibility shall be established and maintained by any one, or a combination, of the following methods:

(a) Evidence of insurance.

(b) Surety bonds payable to the fund for all costs and expenses for containment, abatement, cleanup, and damages resulting from any discharge.

(c) Qualification as a self-insurer.

(d) Other additional evidence of financial responsibility satisfactory to the board.

3901. A bond filed with the board shall be issued by a bonding company authorized to do business in this state.

3902. Any claim for costs of containment, abatement, or cleanup, civil penalties or damages by the state, and any claim for damages by any injured person, may be brought directly against the bond, the insurer, or any other person providing evidence of financial responsibility.

3903. Each owner or operator of a terminal or a vessel subject to the provisions of this division shall designate a person in the state as his legal agent for service of process under this division and such designation shall be filed with the Secretary of State. In the absence of such designation, the Secretary of State shall be the designated agent for purposes of service of process under this division.

Chapter 13. Other Provisions

3910. Nothing in this division shall apply to Division 7 (commencing with Section 13000) of the Water Code, or to the storage, transportation, or transfer of liquefied natural gas or liquefied petroleum gas, or to pollutants discharged into the waters of the state as permitted pursuant to other provisions of state or federal law. In addition, nothing in this division shall limit any power, duty, or responsibility of the State Lands Commission.

3911. If any provision of this division or the application thereof to any person or circumstance is held invalid or preempted by federal law, such invalidity or preemption shall not affect other provisions or applications of the division which can be given effect, and to this end the provisions of this division are severable.

3912. Nothing in this division shall be construed to preclude or restrict a county, city, or other political subdivision of the state from enacting local rules and regulations, by ordinance or otherwise, in furtherance of the intent of this division to promote the general welfare, public health, and public safety. Such rules, regulations, ordinances, or laws shall be valid unless in direct conflict with the provisions of this division or any rule, regulation,

or order of the secretary adopted under authority of this division. However, no county, city, or other political subdivision of the state may adopt or establish a similar program of licensing and fees for the accomplishment of the purposes of this division.

SEC. 4. Section 13350 of the Water Code is amended to read:

13350. (a) Any person who (1) intentionally or negligently violates any cease and desist order hereafter issued, reissued, or amended by a regional board or the state board, or (2) in violation of any waste discharge requirement or other order issued, reissued, or amended by a regional board or the state board, intentionally or negligently discharges waste or causes or permits waste to be deposited where it is discharged into the waters of the state and creates a condition of pollution or nuisance, ~~or (3) causes or permits any oil or any residuary product of petroleum to be deposited in or on any of the waters of the state,~~ except in accordance with waste discharge requirements or other provisions of this division, may be liable civilly in a sum of not to exceed six thousand dollars ($6,000) for each day in which such violation or deposit occurs.

(b) The Attorney General, upon request of a regional board or the state board, shall petition the superior court to impose, assess and recover such sums. Except in the case of a violation of a cease and desist order, a regional board or the state board shall make such request only after a hearing, with due notice of the hearing given to all affected persons. In determining such amount, the court shall take into consideration all relevant circumstances, including but not limited to, the extent of harm caused by the violation, the nature and persistence of the violation, the length of time over which the violation occurs and corrective action, if any, taken by the discharger.

(c) The provisions of Articles 3 (commencing with Section 13330) and 6 (commencing with Section 13360) of this chapter shall apply to proceedings to impose, assess and recover an amount pursuant to this article.

(d) Remedies under this section are in addition to, and do not supersede or limit, any and all other remedies, civil or criminal.

SEC. 5. No appropriation is made by this act, nor is any obligation created thereby under Section 2231 of the Revenue and Taxation Code, for the reimbursement of any local agency for any costs that may be incurred by it in carrying on any program or performing any service required to be carried on or performed by it by this act.

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SENATE BILL No. 841

Introduced by Senator Sieroty

April 6, 1977

An act to amend Section 12805 of the Government Code, and to add Division 4.5 (commencing with Section 900) to the Harbors and Navigation Code, relating to oil terminal facilities and carriers.

LEGISLATIVE COUNSEL'S DIGEST

SB 841, as introduced, Sieroty. Oil terminal facilities and carriers.

Under existing law, there is no special state licensing required for oil terminal facilities used for the transfer of crude oil, refined petroleum products, or their by-products or marine carriers engaged in the transportation of such products.

This bill would create the Department of Waterway Safety in the Resources Agency, and would prohibit the operation of oil terminal facilities used in the transfer of crude oil, refined petroleum products, or their by-products and the operation of vessels engaged in the marine transportation of such products in state waters without submission of proof of financial responsibility and the issuance by the department of a certificate of risk avoidance. The bill would make legislative findings and declarations in such connection, would specify the terms and conditions for issuance of certificates of risk avoidance for such oil terminal facilities and marine carriers, would specify the amount of financial security required for such facilities and carriers, would exempt floating marinas and onshore limited capacity facilities, as defined, from such requirements, and would specify the powers of the department to enforce such provisions. The bill would authorize the department to adopt regulations, not in conflict with federal law, for specified purposes relating to the prevention of oil spills and discharges.

Vote: majority. Appropriation: no. Fiscal committee: yes. State-mandated local program: no.

The people of the State of California do enact as follows:

SECTION 1. Section 12805 of the Government Code is amended to read:

12805. The Resources Agency consists of the State Air Resources Board, the Colorado River Board, the State Energy Resources Conservation and Development Commission, the State Water Resources Control Board and each California regional water quality control board, the State Lands Commission, the Division of State Lands, and the following departments: Conservation; Fish and Game; Forestry; Navigation and Ocean Development; Parks and Recreation; *Waterway Safety;* and Water Resources.

SEC. 2. Division 4.5 (commencing with Section 900) is added to the Harbors and Navigation Code, to read:

DIVISION 4.5. OIL TERMINAL FACILITIES AND CARRIERS

Chapter 1. General Provisions

900. The Legislature finds and declares that because of the danger of spills the marine transportation of crude oil, refined petroleum products, or their by- products by tankers or other carriers so engaged in the coastal waters and inside coastal waters of the state creates a great potential hazard to important natural resources of the state and to jobs and incomes dependent upon these resources. Certain areas of the state's coastal and inside coastal waters have limited space for maneuvering large tankers vessels engaged in the marine transportation of crude oil, refined petroleum products, or their by-products. These waters also contain many natural and man-made obstacles, and at certain times and places contain a high density of commercial, fishing, and pleasure boat traffic. Thus, it is important that large

vessels have sufficient capability for safely and rapidly maneuvering in these waters. It is the intent of the Legislature to reduce the likelihood of oil discharges from tank vessels in the waters of the state and to be prepared to contract the effects of such spills which do occur.

901. As used in this division, "department" means the Department of Waterway Safety.

Chapter 2. Certificates of Risk Avoidance

920. No person may operate, or cause to be operated in this state, an oil terminal facility used or capable of being used in the transfer of crude oil, refined petroleum products, or their by-products without proof of financial responsibility submitted to, and a certificate of risk avoidance issued by, the department pursuant to this division.

921. No person may operate, or cause to be operated, a tank vessel engaged in the marine transportation of crude oil, refined petroleum products or their by-products (1) to or from oil terminal facilities located onshore in the ports, harbors, or elsewhere in the state, (2) to or from deepwater port facilities located offshore in the waters of the state, or (3) through the waters of the state without proof of financial responsibility submitted to, and a certificate of risk avoidance issued by, the department pursuant to this chapter.

922. The department shall prohibit the loading or unloading of a tank vessel subject to the provisions of this chapter, that does not possess a certificate of risk avoidance or proof of financial responsibility, or both the certificate and proof.

923. Certificates of risk avoidance shall be issued on an annual basis subject to such terms and conditions as the department considers to be necessary, and as prescribed by regulation, to carry out the purposes of this chapter.

924. As a condition precedent to the issuance or renewal of a certificate of risk avoidance, the department shall require submission of satisfactory evidence that the applicant has implemented, or is in the process of

implementing, state and federal plans and regulations for control of pollution related to crude oil, refined petroleum products, or their by-products and the abatement of the pollution when a discharge occurs.

925. In addition to the evidence supplied under Section 924, applicants for an oil terminal facility certificate shall demonstrate that they can provide all necessary equipment, personnel, and supplies to prevent, contain, and remove discharges of oil and other pollutants, and shall submit information to the department in a form satisfactory to it, describing all of the following:

(a) The barrel or other measurement capacity of the terminal facility.

(b) All containment and removal equipment, including, but not limited to, vehicles, vessels, pumps, skimmers, booms, chemicals, and communications devices to which the facility has access, whether through direct ownership or by contract or membership in an oil cleanup organization.

(c) The terms of agreement and operation plan of any discharge cleanup organization to which the owner or operator of the terminal facility belongs.

926. In addition to the evidence supplied under Sections 924 and 925, applicants for a marine carrier certificate shall demonstrate that they can provide all necessary equipment, personnel, and supplies to prevent, contain, and remove discharges of oil and other pollutants, and shall submit information to the department in a form satisfactory to it, describing all of the following:

(a) The name and description of each tank vessel for which a certificate is sought that is engaged in, used, or capable of being used by the carrier for the marine transportation of crude oil, refined petroleum products, or their by-products to and from onshore and offshore oil terminal facilities in this state. The vessel description shall include, but is not limited to, the overall length, beam, draft, gross tonnage, deadweight tonnage, net tonnage, and design capacity for transporting crude oil, refined petroleum products, or their by-products, and a

detailed statement as to the tank vessel's seaworthiness. The department may, in addition, require that the carrier furnish a marine survey of the tank vessel's condition.

(b) A projection of the number of visits each tank vessel will make annually to or from an oil terminal facility in the state, or through the waters of the state.

(c) All containment and removal equipment, including, but not limited to, vehicles, vessels, pumps, skimmers, booms, chemicals, and communication devices to which the carrier or the tank vessel has access, whether through direct ownership or by contract or membership in an approved discharge cleanup organization.

(d) The terms of agreement and operation plan of any discharge cleanup organization to which the carrier or the owner or operator of the tank vessel belongs.

927. Upon showing of satisfactory containment and removal or cleanup capability under this chapter, the department shall issue the applicant a certificate of risk avoidance for each terminal facility and related appurtenances or for each tank vessel. The department may assess a fee for the processing of an application for the issuance or renewal of a certificate of risk avoidance under this section. This fee shall be reasonably related to the administrative costs of verifying the data submitted under Sections 924, 925, and 926.

928. Oil terminal facilities engaged in the transfer of, and carriers engaged in the marine transportation of crude oil, refined petroleum products, or their by-products, that are applicants for, or a holder of, a certificate of risk avoidance under this section are subject to inspection by the department to ensure compliance with the provisions of this division.

Chapter 3. Proof of Financial Responsibility

940. Carriers and facilities subject to the provisions of this division shall present to the department evidence of insurance bonding, or other forms of financial responsibility sufficient to satisfy any reasonably foreseeable liability of a carrier or facility for property

damage, personal injuries, loss of income or other losses resulting from the unlawful discharge of crude oil, refined petroleum products, or their by-products.

941. The amount of financial responsibility required for each carrier or facility shall not be less than twenty million dollars ($20,000,000), or an amount required under applicable federal law or regulation.

CHAPTER 4. EXEMPTIONS

960. Because of the restricted nature of marina and limited capacity facility operations and the minimal danger to the environment posed by their activities, a floating marina used or capable of being used to store less than 500 barrels of refined petroleum products or their by-products, or an onshore limited capacity facility used or capable of being used to store less than 2,500 barrels of refined petroleum products or their by-products are exempt from the proof of financial responsibility requirements of Chapter 3 (commencing with Section 940) and the certificate of risk avoidance requirements of Chapter 2 (commencing with Section 920).

961. For the purposes of this chapter:

(a) "Marina" means a person or facility engaged in the business, whether onshore or offshore, of servicing the fuel requirements of pleasure craft, fishing boats, and other commercial vessels, where the purchaser and the consumer are the same entity, and the fuel capacity of the servicing or serviced vessel is less than 500 barrels of refined petroleum products or their by-products.

(b) "Limited capacity facility" means a small tank farm, small bulk fuel storage facility, or other onshore facility storing refined petroleum products or their by-products, except asphalt, and which is engaged in the business of servicing the requirements of product transporters and vendors, or storing the fuel requirements for village domestic, school or commercial use, including, but not limited to, fish processing, logging operations, construction projects, or electric power generation.

CHAPTER 5. REGULATIONS

980. The department shall adopt regulations to carry out the purposes of this division which do not conflict with federal law or regulations issued by any federal department or agency, including, but not limited to, the following:

(a) Operating and inspection requirements for oil terminal facilities, tank vessels, personnel, equipment, supplies and other matters relating to the insured's operations under Chapter 2 (commencing with Section 920).

(b) Procedures and methods of reporting discharges and other occurrences prohibited by this chapter.

(c) Procedures, methods, means and equipment to be used by persons subject to this chapter and the implementing regulations.

(d) Procedures, methods, means and equipment to be used in the removal of oil and petroleum pollutants.

(e) Development and implementation of criteria and plans to meet oil and petroleum pollution discharges, spills, or other occurrences of various degrees and kinds.

(f) The establishment from time to time of control districts comprising sections of the state's coast and the establishment of regulations which may be required to meet the particular requirements of each district.

(g) Requirements for the safety and operation of tank vessels, barges, tugs, motor vehicles, motorized equipment, and other equipment relating to the use and operation of terminals, facilities, and refineries and the approach and departure from terminals, facilities, and refineries.

(h) Such other regulations that may be required by or for emergency conditions or that reasonably may be necessary to carry out the purposes of this division.

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Initial Chemical Spill Report to
State Department of Fish & Game, Region III
January-June 1977

Date 1977	Spill #	Location	Chemical Spilled	Approximate Amount	Remarks
1-3	2064	Santa Rosa	Sudsey Water	*	60-100 dead carp
1-4	2066	San Francisco	Lead based paint	*	
1-4	2067	Oakland	A "Blue Chemical"	*	
1-24	2070	Oakland	Foam on water	100-200 Ft.	
1-27	2073	Cupertino	mineral oil	20,000 gal.	Bombing at PG&E substation
1-28	2075	Napa	red wine	1,000 gal.	
2-23	2081	Hwy 680, Pleasant Hill	jet fuel	4,000 gal.	water flushing, vacumn pick up.
3-3	2084	Rogers Creek	"yellow foamy stuff"	*	not found
3-10	2084A	Richmond	sodium chloride, sodium sulphate, fungicides, various salts	300 gal.	
3-22	2087	Richmond	gasoline		
4-6	2097	PG & E, geysers	condensate	250 gals/min. lasted 10 min.	
4-7	2098	*	asphalt & oil (road type)	*	

*information not recorded

Date 1977	Spill #	Location	Chemical Spilled	Approximate Amount	Remarks
4-8	2099	San Jose	chronic acid	500 gal.	personal error
4-11	2102	Hunters Pt. S.F.	contaminated orange soda	7,000 cans	naval vessel naval clean up
4-15	2106	Richmond	cosmolene	*	
4-18	2108	PG & E	condensate	500 gal/min. for 44 min.	3 salamanders in creek not affected
4-25	2109	Mill Valley	white substance paint, or soap	*	
5-6	2112	PG & E, geysers	condensate	750 gal/min. 8 min. 6,000 gal.	did not reach state waters
5-12	2113	South S.F.	solvent	1,000 gal.	Dupont spill entirely contained
5-16	2114	PG & E, geyser	condensate	3,750 gal.	no fish loss observed
5-20	2116	South S.F.	redwood laytex stain	5-10 gal.	
5-23	2118	Beth. Steel Pier 3	bilge oil, paint thinner, and paint	250'x50' sheen	area boomed
5-24	2119	Hwy 4	HCL acid	*	truck accident
6-13	2120	Santa Clara	red paint or dye	20 gal.	no water affected
6-23	2126	Richmond	Licmin sulphmate (wood molasses)	2 tons	broken valve

APPENDIX C

2 September 1977

COAST GUARD COMMENTS ON CITED PROBLEM AREAS IN TECHNICAL MEMORANDUM 22

TECHNOLOGY

SPILL PREVENTION

a. A list of recently proposed or finalized Coast Guard regulations as pertain to the design, manning, and operation of vessels is attached as enclosure (1) for your reference.

SPILL IDENTIFICATION

a. Currently the primary incentive for the notification of a spill (oil) event is section 311(b)(5) of the Federal Water Pollution Control Act of 1972 (FWPCA) which requires the spiller, vis a vis the alternative of a criminal penalty, to notify the Coast Guard. Whereas, the EPA has not designated what is a hazardous substance this requirement does not extend to chemical spills.

b. A listing of Coast Guard technical reports pertaining to possible pollution monitoring systems is attached as enclosure (2).

SPILL CONTAINMENT AND CLEANUP -- No comment.

REGULATION AND MANAGEMENT

SPILL PREVENTION

a. The requirement for SPCC Plans is authorized by section 311(j) of the FWPCA, since the list of hazardous substances has not been designated, the EPA cannot extend the jurisdiction of the SPCC requirement to chemical facilities.

b. The Coast Guard under the authority of the Port and Waterways Safety Act and the Tank Vessel Act do regulate, for the purpose of vessel and port safety, the shipping, stowage, segregation, and labelling of hazardous materials. These regulations are set forth in various sections of Title 46 and 49 of the Code of Federal Regulations.

c. The Coast Guard Pollution Information Reporting System (PIRS) does include spills of hazardous chemicals. A list of sample chemicals spills occuring in the Bay Area during 1976 is attached as enclosure (3). A listing of PIRS chemical codes entries is attached as enclosure (4).

VESSEL TRAFFIC SYSTEM

a. It is important to note that the Vessel Traffic Service as a system extends throughout the Bay Region, including the bay tributaries extending north and east to Sacramento and Stockton, and south to Redwood City. However, the radar aspect of the system does not extend northward of approximately the Richmond-San Rafael Bridge. The radiotelephone procedures and voluntary vessel traffic separation scheme exist throughout the entire system.

b. A comprehensive technical study was conducted in 1970 as to the vessel traffic needs of San Francisco Bay. Further, it is our understanding that the feasibility of a radar substation in San Pablo Bay was considered. We have initiated the proper actions to obtain the background materials that pertain to the managerial decisions that established the Vessel Traffic Service in its present configuration.

LOCAL CONTINGENCY PLANS

a. The special studies report itself does not clearly set forth data upon which to base conclusions that local contingency planning is either inadequate or adequate, coordinated or fragmented. Many problems exist within all concerned agencies, however are these problems of management or interagency coordination? It is misleading to imply that organizations in the bay area are not fully cooperative with each other, especially in response to spill situations.

b. In regard to your proposal for a supervisory agency to coordinate local contingency planning, it is recommended you research representation on the State Interagency Oil Spill Commission (SIOSC) or the Regional Response Team (RRT) as a vehicle for this purpose. I am sure you will find these organizations fulfill the objectives you desire to obtain.

Enclosures:
(1) Recently proposed & finalized Coast Guard regulations.
(2) Coast Guard technical reports on pollution monitoring.
(3) Sample listing of PIRS entered chemicals spills in 1976.
(4) PIRS chemical codes.
(5) VTS Operating Procedures.

1. FR Thursday 24 JUN 76 Proposed Rules
<u>CARRIAGE OF BULK DANGEROUS OR EXTREMELY FLAMMABLE CARGOES</u> (46 CFR 1, 2, 24, 30, 31, 32, 39, 40, 42, 70, 90, 98, 110, 151, 153)

1. Regulations govern design, construction, and operation of all Self-Propelled U. S. Flag Vessels engaged in the carriage of certain bulk dangerous cargoes.

2. FR Monday 31 JAN 77 Final Rules Effective 1 JUN 77
<u>NAVIGATION SAFETY AND VESSEL INSPECTION REGULATIONS</u> (33 CFR 164)
Applies to all vessels 1600 GT or more.

1. Navigation underway - general.
   (a) Constantly manned wheelhouse with competent personnel.
2. Navigation confined waters.
   (a) Constantly manned engine room/and main control.
3. Requires anchor watch when anchored.
4. Requires testing of critical systems (steering/alarms/emergency generator/main propulsion machinery).
5. Requires charts & publications.
6. Equipment requirements.
   (a) Radar.
   (b) Magnetic Compass/Deviation Charts.
   (c) Gyro compass.
   (d) Rudder angle indicator.
   (e) Vessel characteristics.
   (f) Radio telephone.

3. FR Monday 31 JAN 77 Proposed Rules
<u>NAVIGATION SAFETY REQUIREMENTS</u> (33 CFR 164)
Applies to all vessels 1600 GT or more.

1. Requires Loran C receivers on all vessels.

4. FR 25 APR 77 Proposed Rules
<u>TANKERMAN REQUIREMENTS; QUALIFICATIONS OF PERSONS IN CHARGE OF OIL TRANSFER OPERATIONS</u> (33 CFR 155)(46 CFR 10, 12, 30, 31, 35, 70, 90, 98, 105, 151, & 157)

1. More stringent qualifications for licensing officers and seaman as tankermen. Cargoes that persons qualify to handle will specifically be noted on the license.
2. Specifies number and type of tankerman required for different types of cargo handling situations.

5. FR Monday 9 MAY 77 Proposed Rules
<u>TANK VESSELS - MANUAL OF CARGO TRANSFER PROCEDURES</u> (46 CFR 35)

1. Requires vessel to have manual on cargo transfer procedures.
   (a) Listing products handles/transfer procedures.
   (b) Line diagram of piping/shut off valves.
   (c) Persons required for transfer and duties.
   (d) Operation of emergency shutdown.

Enclosure (V)

RECENT COAST GUARD TECHNICAL REPORTS CONCERNED WITH LOCAL POLLUTION MONITORING

1. Coast Guard Technical Report 39-75.

   Petroleum oil detection buoy system.

2. Coast Guard Technical Report 87-76.

   Survey of equipment and techniques to identify and qualify discharged hazardous chemicals.

3. Coast Guard Technical Report 121-76.

   A preliminary test of a government-owned local area oil on water surveillance system.

4. Coast Guard Technical Report 127-76.

   Development of buoy mounted hydrocarbon vapor systems for use in local area pollution surveillance systems.

These reports are available for review in room 354, Twelfth Coast Guard District, 630 Sansome Street, San Francisco.

Enclosure (2)

CE OF THE SECRETARY
ESOURCES BUILDING
1416 NINTH STREET
95814

(916) 445-5656

tment of Conservation
tment of Fish and Game
tment of Forestry
tment of Navigation and
Ocean Development
tment of Parks and Recreation
tment of Water Resources

EDMUND G. BROWN JR.
GOVERNOR OF
CALIFORNIA

Air Resources Board
California Coastal Commission
California Conservation Corps
Colorado River Board
Energy Resources Conservation and
Development Commission
Regional Water Quality Control Boards
San Francisco Bay Conservation and
Development Commission
Solid Waste Management Board
State Coastal Conservancy
State Lands Commission
State Reclamation Board
State Water Resources Control Board

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

MAR 2 8 1978

Mr. B. J. Miller
208 Coordinator
ABAG
Hotel Claremont
Berkeley, CA 94705

Dear Mr. Miller:

In a telephone conversation with Trevor O'Neill on 21 March, Terry Bursztynsky requested that California's Interagency Tanker Task Force submit a formal response to the proposed ABAG recommendation that the Task Force conduct a comprehensive study of the role and responsibility of local, State, and Federal agencies regarding spills of non-petroleum hazardous substances in the waters of California. As chairman of the Task Force, I am pleased to respond to your request.

I share ABAG's concern regarding the toxicity and potential impact of non-petroleum hazardous substances in the inland, coastal, and marine waters of California. For several reasons, though, I believe it would be inappropriate for the Tanker Task Force to carry out this proposed study.

The primary purpose of the Task Force is to address issues and coordinate information and actions of State agencies in the general area of petroleum tanker operations, safety, and navigation. This being the case, a study of non-petroleum hazardous substance spills, while of considerable importance to California, falls outside our primary mission. Members of the Task Force were selected on the basis of their expertise or agency responsibilities regarding petroleum tanker activities. These skills and agency responsibilities are, for the most part, unrelated to the subject of non-petroleum hazardous substances.

Finally, I would like to point out that the Task Force intends to release its final report in June of this year. I cannot predict what action the Legislature or Administration might take, but the present Tanker Task Force may go out of business when our final report is submitted. For this reason, I would urge that ABAG direct its recommendation to a State agency having more longevity and permanent statutory authority.

I suggest that ABAG consult with the State Water Resources Control Board, and with the Department of Fish and Game. The SWRCB has broad statutory responsibilities for water quality, while DFG implements California's oil and hazardous materials spill contingency plan. Either or both of these agencies might be interested in undertaking such a study, and they ought to be able to provide informed guidance.

In addition, Assemblyman Gary Hart recently introduced a bill, AB 3220, which would increase State penalties and liability for spills of oil and other hazardous substances. Copies of the bill are not yet available, but I have enclosed a fact sheet and press release for your information.

Sincerely yours,

James W. Rote

James W. Rote
Assistant Secretary for Marine
and Coastal Resources

attachment

FROM THE OFFICE OF
ASSEMBLYMAN GARY K. HART

State Capitol, Room 5136
Sacramento, CA 95814

AB 3220

FOR RELEASE:

MARCH 27, 1978

NEWS RELEASE NO. 67

$20,000/day

HART ANNOUNCES OIL AND HAZARDOUS CHEMICAL SPILL MEASURE

Stating that "We must protect California from 'Amoco Cadiz-type' disasters, " Assemblyman Gary Hart today introduced legislation to stiffen State law for spills of oil and hazardous chemicals. Joining Hart to support the legislation was John Bryson, Chairman of the State Water Resources Control Board, the agency with primary responsibility for protecting water quality in California.

"Existing law is a confusing patchwork that, in many instances, does not significantly discourage oil pollution, " said Hart. "My bill will close loopholes in the law and make prevention more economical than disaster. It contains strong penalties to deter careless action." Hart's bill is based on the experience and recommendations of the State Water Resources Control Board and covers all spills whether on land or water.

In 19~~67~~76, state officials investigated 349 reported spills of oil and hazardous chemicals, with the number expected to increase due to expansion of offshore drilling and increased oil imports from Alaska and foreign countries.

"Under existing law, a polluter may escape liability, or be subject to very limited liability, unless the State proves negligence or intent to spill, " Hart said. "Because the facts about a spill are usually known only to the polluter, this is a costly and unworkable process." The Hart Bill sets a stricter standard of liability and requires

only that the source of the spill be under the control of the polluter. "Birds, fish and beach goers do not care if the polluter is negligent; the damage is the same." said Assemblyman Hart. Hart represents Santa Barbara, the site of a major oil spill in 1969. He predicted that his bill would spur preventative activity.

State Water Resources Control Board Chairman John Bryson agreed that changes in the law were badly needed. Bryson emphasized that the Hart bill would increase a polluter's incentive to clean up after a spill by basing liability on the time taken to clean up where clean up is possible. "Existing law only provides full compensation for each day the actual spill continues, not each day the oil or other pollutant remains in the environment without clean up," said Bryson. "A case brought by the San Francisco Bay Regional Water Quality Control Board involving a waste oil spill from a tank farm in Oakland shows the problem. The court was only able to award full damages for the four days the oil actually spilled, rather than for the additional days required to complete clean up operations," he continued. " The court found additional incalculable damage but concluded that no recovery was allowed under the law even though the damage was far in excess of the liability imposed."

"The Amoco Cadiz spill is another example," said Bryson,"The damage has just begun; it does not stop when the oil is no longer spilling." Bryson feels that the State needs a tough law as a deterrent. "Super tankers require super care." he added.

Hart's bill also covers spills of hazardous chemicals such as chlorine and toxic pesticides. "The recent chemical spills in Florida and Tennessee and the Amoco Cadiz catastrophe show that it is imperative that we move quickly to deter similar incidents in California." said Hart. "We must see to it that if a disaster occurs here, California citizens are fully compensated and swift clean up is ensured."

FACT SHEET
OIL and HAZARDOUS SUBSTANCE SPILL MEASURE

WHAT SUBSTANCES DOES THE BILL COVER?

- Oil and refined petroleum products
- Hazardous substances, including chlorine, toxic pesticides, and dangerous industrial chemicals.

WHAT TYPES OF SPILLS DOES IT COVER?

- Ships, trains, trucks, pipelines, storage tanks — whether on water or land.

WHAT ACTIONS WOULD BE TAKEN WHEN SPILLS OCCUR?

- State officials would direct cleanup operations and emergency response.
- Citations would be issued setting the amount of liability subject to review at administrative hearings.
- All injured parties may sue on losses caused by the spill, including cleanup costs and losses from damage to natural resources.

WHO WILL IMPLEMENT THE LAW?

- Citations may be issued by the Department of Fish and Game, the State Water Resources Control Board and Regional Water Quality Control Boards and any other state agency designated by the Governor.

HOW IS EXISTING LAW INADEQUATE?

- Existing law does not allow adequate recovery for all damages.
- Existing law does not contain any comprehensive system for recovery of damages due to hazardous substance spills.
- Existing law sets too weak a standard of liability.
- Existing law is a patchwork of overlapping, inconsistent and inadequate statutes.

HOW WILL THE BILL LESSEN POLLUTION?

- Encourages prevention: establishes a strict liability standard and requires polluters to pay for all damages caused by spills. Will encourage the utmost care in the handling, transporting and storing of oil and hazardous substances.
- Encourages rapid cleanup action: Where cleanup is possible, citations will set liability based on the time taken to cleanup.
- Provides for full compensation: The bill allows recovery for the full range of losses caused by spills and includes procedures to simplify recovery when a large number of people are affected.

HOW MANY SPILLS WERE THERE IN CALIFORNIA LAST YEAR THAT WOULD COME UNDER THE NEW LAW?

- Based on past figures, the number may exceed 500. In 1976, state officials investigated 349 spills of oil and hazardous substances.
- The number of spills is likely to increase. Offshore oil production in the Santa Barbara area is projected to increase 50 percent between 1978 and 1985. Oil transported by tankers from Alaska and foreign countries into California will nearly double between 1977 and 1985.

MARCH 27, 1978

BACKGROUND INFORMATION

THE SPILL PROBLEM

Number of Spills

Spills of oil and hazardous substances occur almost every day in California. In 1976 state officials investigated 349 reported spills, totaling over 30,000 barrels. Many spills go unreported. Major disasters like the 1971 tanker collision in the San Francisco Bay which spilled 800,000 gallons of oil and the tanker Sansinena explosion in Los Angeles Harbor demonstrate the problem.

With resumption of offshore oil drilling and increased oil tanker traffic to California from Alaska, the risk of new and major oil spills along the California coast is proportionately increased. Oil production in the Santa Barbara Federal Offshore area is projected to increase 50 percent between 1978 and 1985, from 100,000 barrels per day to 150,000 barrels per day. Oil transported into California from Alaska and foreign countries will nearly double between 1977 and 1985, from 1,079,000 barrels per day to 1,905,000 barrels per day.

Damages Caused by Spills and Costs of Cleanup

The most noticeable damage caused by an oil spill is probably the fouling of recreational beaches and shorefront property. Tons of oil are washed ashore each year, rendering beaches unfit for swimming and filling the air with unpleasant odors. Besides the annoyance that this causes a vacationing public, economic loss may be considerable. It was estimated that a serious oil spill off Long Island during the summer months would cost resort and beach owner-operators thirty million dollars. Oil spills also create navigational and fire hazards in harbors, ports and marinas.

Spills of both oil and hazardous chemicals from refineries, pipelines, trucks and trains also present a serious problem. A stretch of railway north of Shasta Lake has been the scene of several derailments. One derailment spilled several hazardous chemicals, including chlorine-based detergents, into the Sacramento River, killing over 6,000 rainbow trout. Another derailment spilled over 2,000 gallons of diesel fuel and oil into the same river.

Damages from oil spills are both obvious and subtle. Obvious damages occur when fish, shellfish and waterfowl die after contact with the floating oil. However, even slight, non-fatal contact may render their flesh inedible and have great impacts on any fishing industry.
A 31,000 gallon spill of heavy oil off Newport, Rhode Island, caused the virtual destruction of the entire oyster fishery of Narragansett Bay. Worse than the initial kill, however, is the disasterous interruption of the ecological food chain. For example, tiny organisms which oysters feed on will not grow where there is even the slightest trace of oil on the water. Such effects are serious because it may take ten pounds of plant matter to produce one pound of fish.

In a case involving waste oil spilled from a tank farm in Oakland, the State was able to prove $38,000 in measurable damages to birdlife alone. However, much of the damage caused by spills is unquantifiable. As the court said, "Damage to other kinds of wildlife including marine fauna was incalculable".

(more)

In 1967 it cost $15 million to clean up the 97,222 tons of oil spilled by the Torrey Canyon in the English Channel. The 13,888-ton oil spill of the Santa Barbara coast in 1969 cost about $8.5 million to cleanup. The recent Amoco Cadiz catastrophe shows the potential scope of disaster. 220,000 tons of crude oil were spilled along the coast of France, with cleanup initially impossible due to bad weather and rough sea conditions.

THE HART BILL

Existing law is a patchwork of overlapping, inconsistent and inadequate statutes.

Under existing law, actions to recover damages from oil spills can be brought under the Fish and Game Code, the Harbors and Navigation Code, the Government Code, the Water Code, common law, and admirality law. This patchwork of laws benefits neither the public nor the oil companies. These laws impose inconsistent standards and leave gaps in coverage. The Hart Bill consolidates these laws and permits the state agencies responsible for control of oil spills to respond to a spill with a single strong enforcement action.

Existing law does not allow adequate recovery for all damages.

For example, under existing law, the State's recovery for unquantifiable environmental and aesthetic damages resulting from even a spill like the Amoco Cadiz could be limited to $6,000 for each day oil is actually spilled. The real injury, however, may be caused by the length of time the oil or other substance remains on the water or land. The Hart Bill would allow recovery to be measured until the spill is actually cleaned up or by the amount of oil or hazardous substance actually spilled. This approach encourages rapid cleanup and sets liability at a figure commensurate with the harm caused.

Existing law does not contain any comprehensive system for recovery of damages due to hazardous substance spills.

Existing law is directed to oil or petroleum spills. However, spills of hazardous substances are potentially more serious. EPA officials say that at least 700 spills of hazardous substances occur each year from tank cars, train derailments, ships, rusty valves and pipes, and people who deliberately pour chemicals into sewer systems, ditches, and rivers. While these spills cause fish kills and wildlife destruction, they have also resulted in contaminated drinking water, evacuation of communities and even loss of life, as happened in Tennessee and Florida last month.

The Hart Bill extends the system used for oil spills to cover hazardous substances.

Existing law sets too weak a standard of liability.

Under existing law, the spiller may escape liability, or be subject to very limited liability, unless the state proves negligence or intent to spill. Since the full facts about the spill are usually known only to the polluter, negligence is difficult and time-consuming to prove. The Hart Bill sets a stricter standard of liability and requires only that the source of the spill be under the control of the polluter.

- - - -

Water Quality Management Plans

Further S.F. Bay
Modeling Results - II

Technical Memorandum No. 23
August 2, 1977

This memo is a continuation of Water Quality Management Plans Technical Memorandum No. 21: Further S.F. Bay Modeling Results, July 5, 1977. It presents water quality modeling results for certain alternatives to the Base Case projections, and expands and refines other results in Technical Memo 21 in response to comments from the Environmental Management Plan Advisory Committees. The assumptions behind the water quality results are detailed in the above Technical Memo.

The first figures (p. 4,5) present the dissolved oxygen levels in the Bay with benthic demand taken into account in the South Bay. The agreement with observed data is quite good. These figures replace p.14 and 15 of Technical Memo 21.

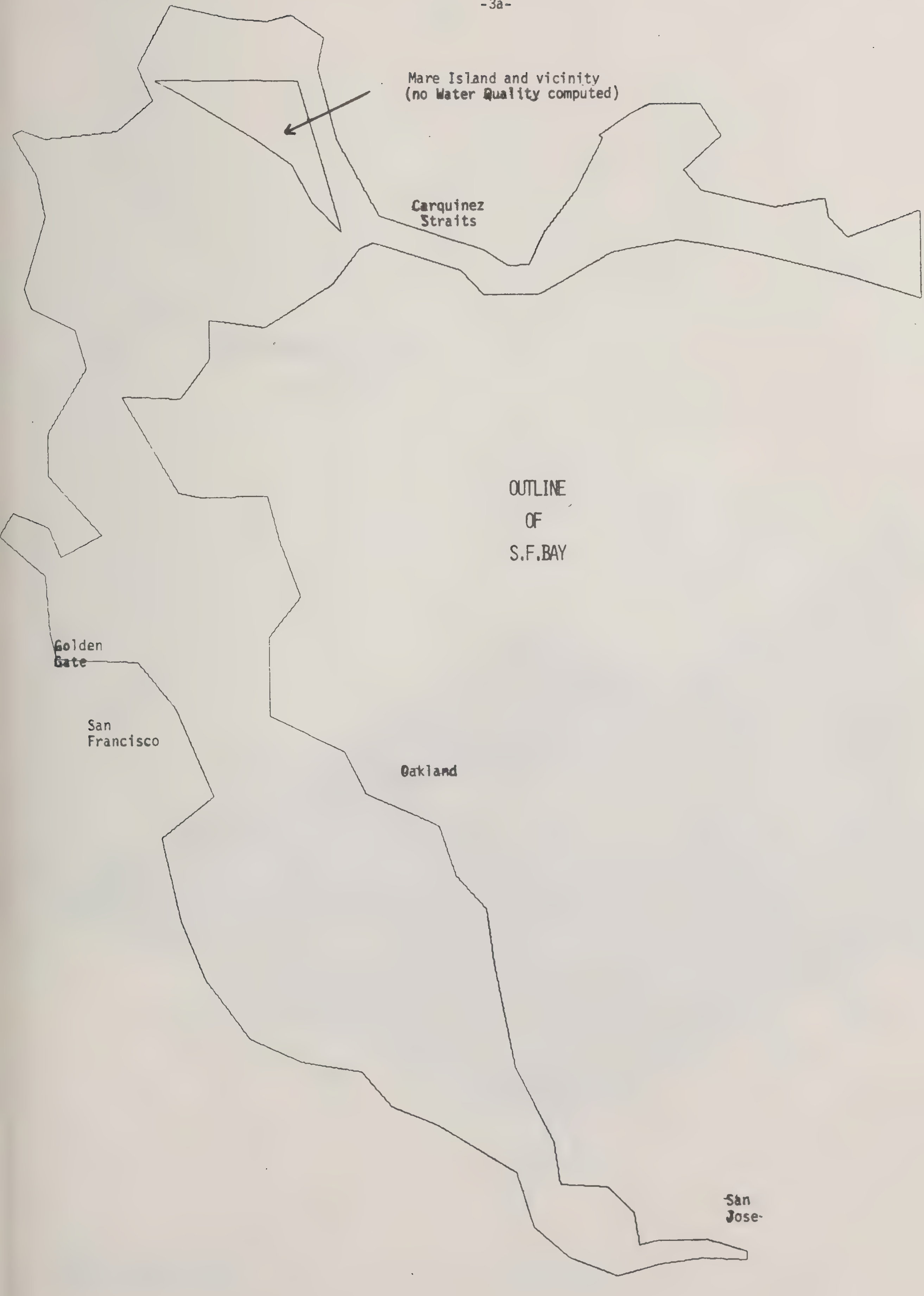
The next group of figures (p. 6-15) presents water quality results in 2000 if industrial dischargers conform to Best Practical Treatment (BPT) rather than Best Available Treatment (BAT) technology. These should be compared with the BAT results of p. 36-45 in Tech Memo 21.

An alternative to future outfall locations is analyzed in the next group of figures, p.16-25, where the Bay is modeled in 2000 with no South Bay "Super Sewer". For these runs, the San Jose, Sunnyvale, and Palo Atlo discharges were kept in their present locations south of the Dumbarton Bridge. It is notable that the nutrients show extremely high levels, since nutrient loadings from these plants are projected to increase in the future.

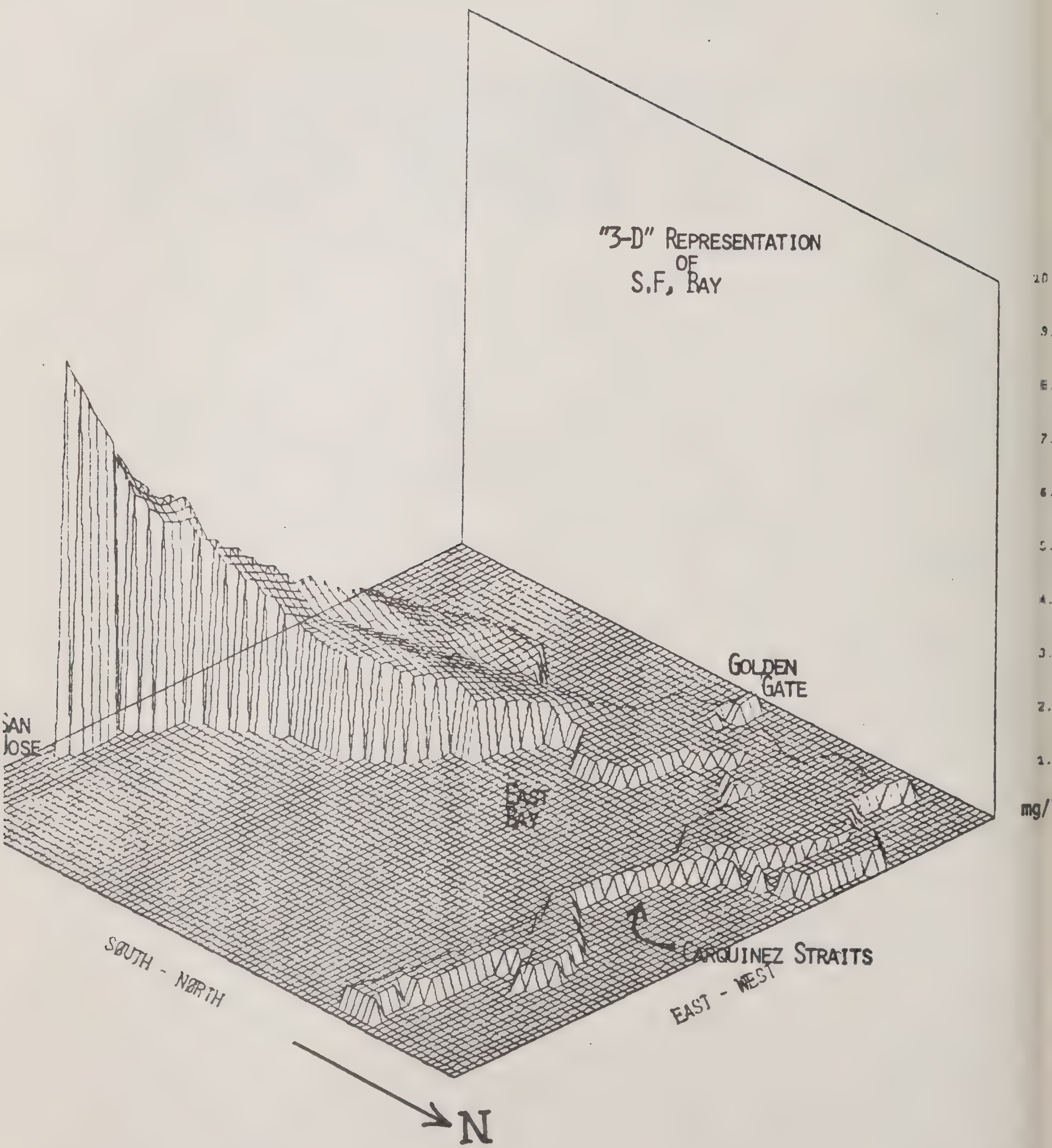
Finally, the water quality effects of the design storm of Tech Memo 21 are examined on a daily basis. Pages26-49 demonstrate the recovery from the three day storm and give an indication of the duration of the oxygen depression and pollutant buildup from runoff. It should be noted that the pollutograph (the time history of the pollutants reaching the Bay) is artificial, with a uniform three day intensity assumed. This will tend to exaggerate the severity of the conditions at the beginning of the storm, since there is in reality a more gradual arrival of the storm runoff into the Bay. It is intended to make refinements in this area.

FIGURES

Following are computer-generated plots of SF Bay water quality, for the pollutants and conditions described in the text. The first two figures are examples, with extra labeling for clarity. Each map is presented twice--first as a standard contour plot of pollutant isopleths (lines of equal pollutant concentrations), and then in a "3-D" format. All units are mg/l (milligrams per liter).



Mare Island and vicinity
(no Water Quality computed)
Carquinez
Straits
OUTLINE
OF
S.F.BAY
Golden
Gate
San
Francisco
Oakland
San
Jose


"3-D" REPRESENTATION
OF
S.F. BAY
SAN
JOSE
GOLDEN
GATE
EAST
BAY
CARQUINEZ STRAITS
SOUTH - NORTH
EAST - WEST
N
10
9
8
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6
5
4
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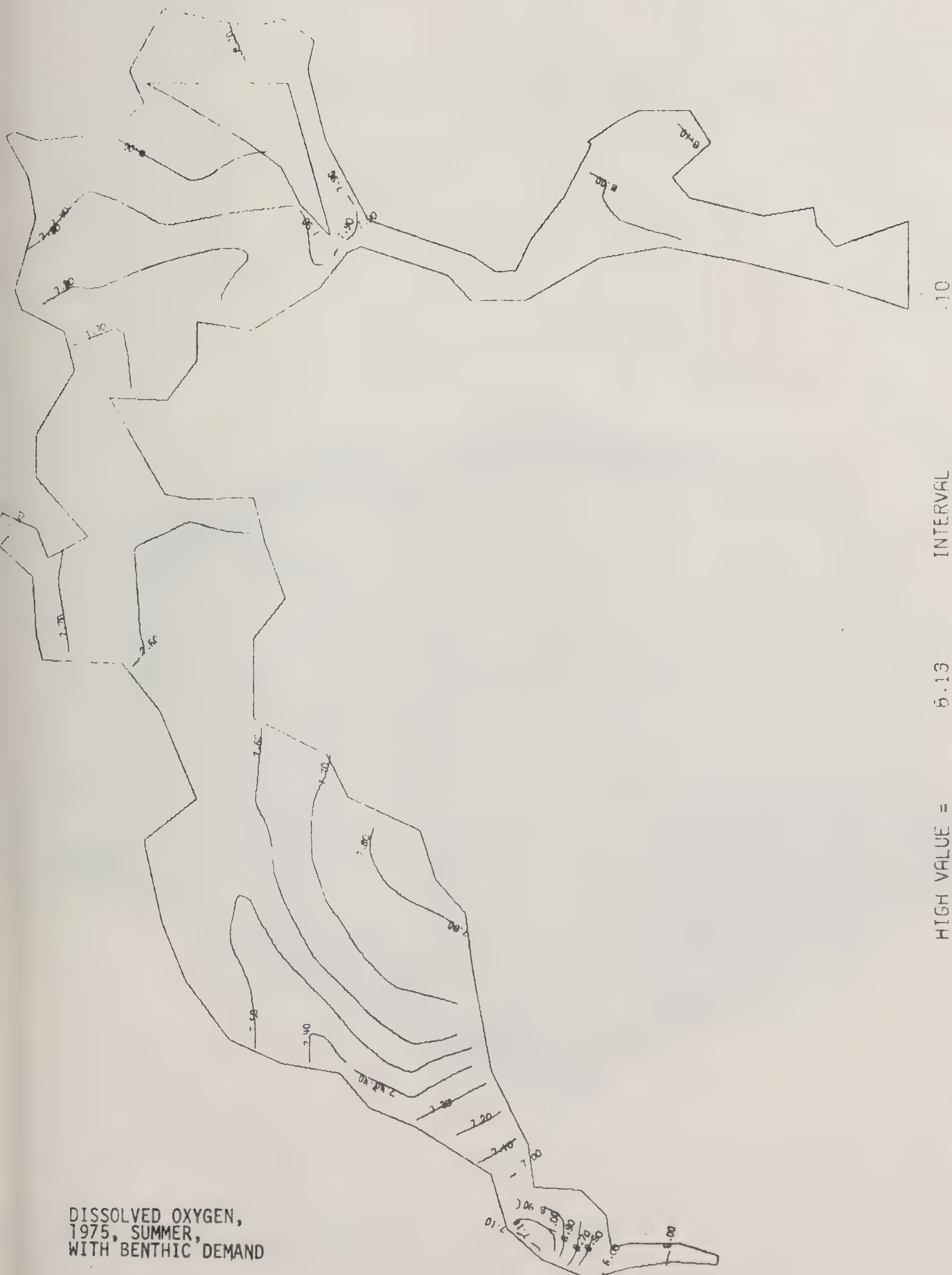
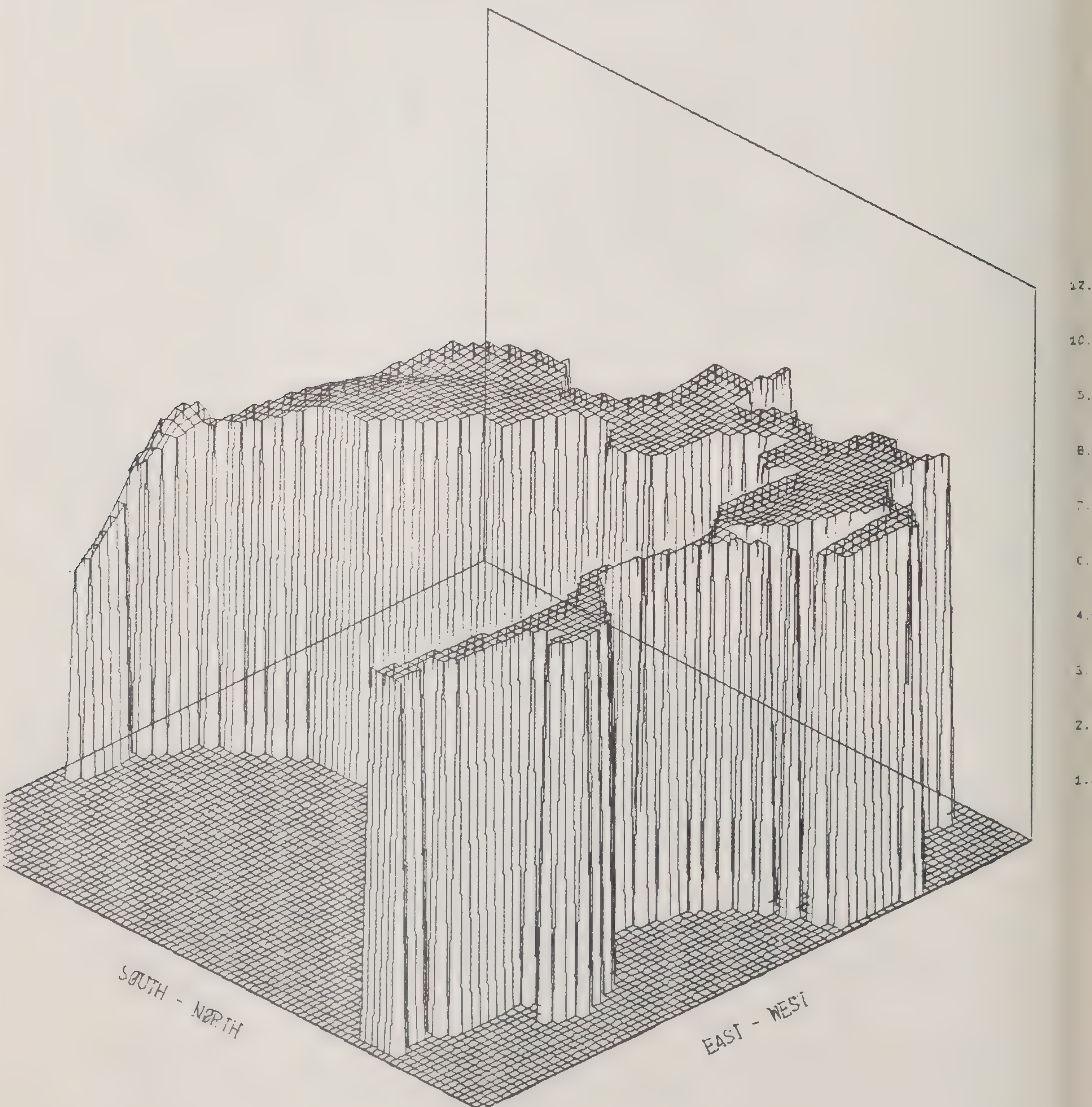
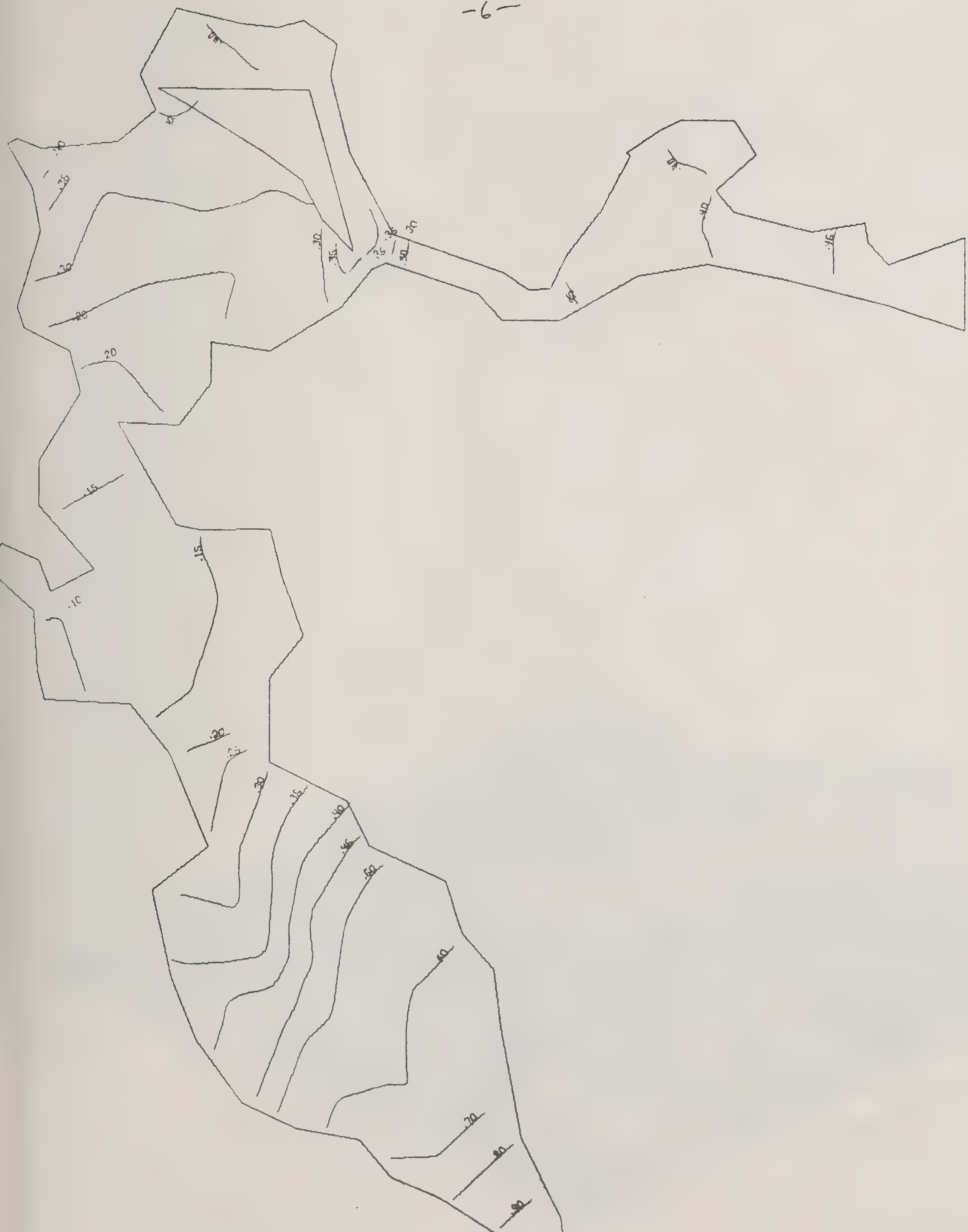
2
1
mg/



DISSOLVED OXYGEN,
1975, SUMMER,
WITH BENTHIC DEMAND

DISSØLVED ØXYGEN, 1975, SUMMER--WITH BENTHIC DEMAND

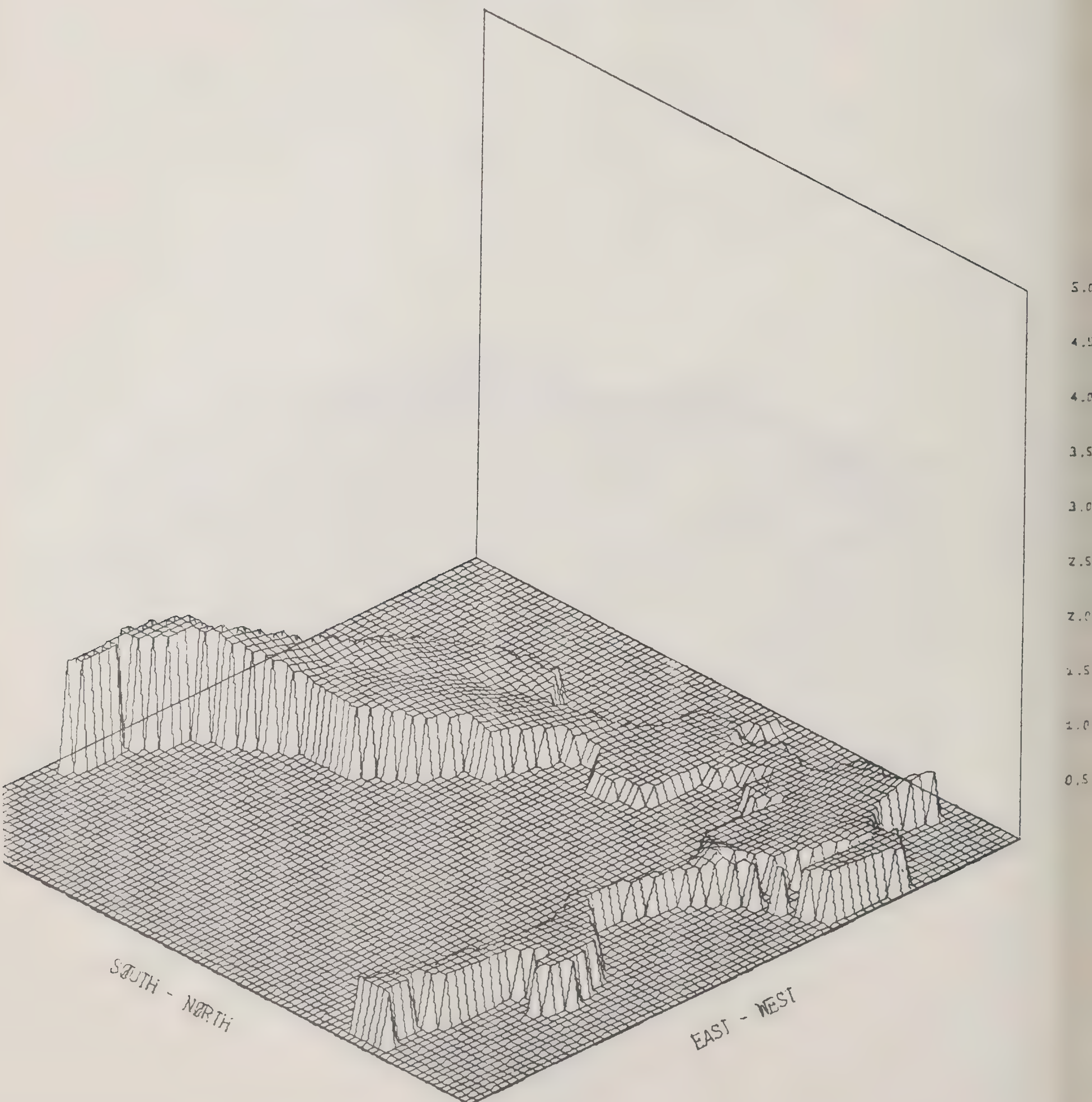


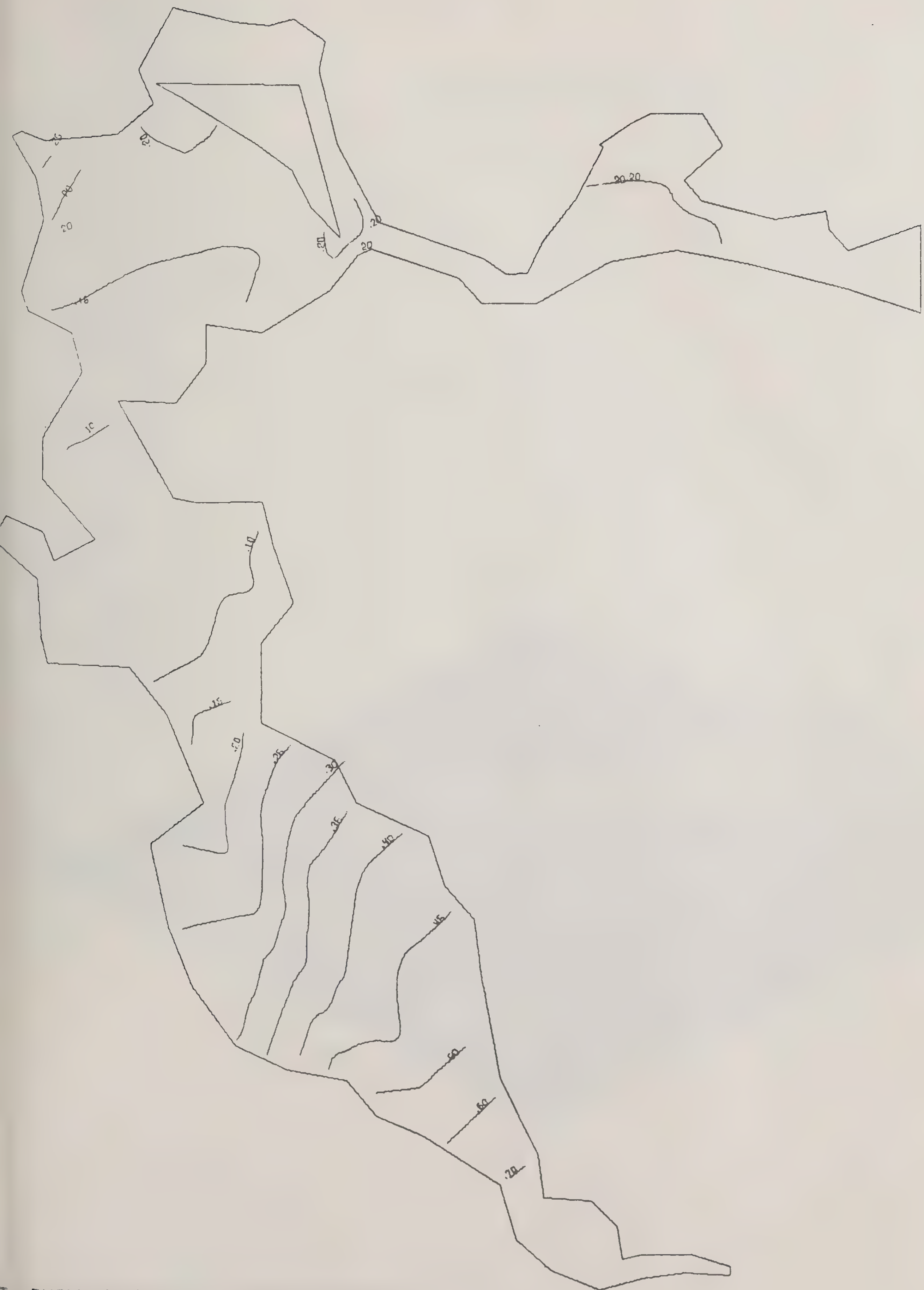


HIGH VALUE = .99 INTERVAL .25

TAL NITROGEN (MG/L),2000,SUMMER--BPT

TØTAL NITRØGEN (MG/L),2000,SUMMER--BPT

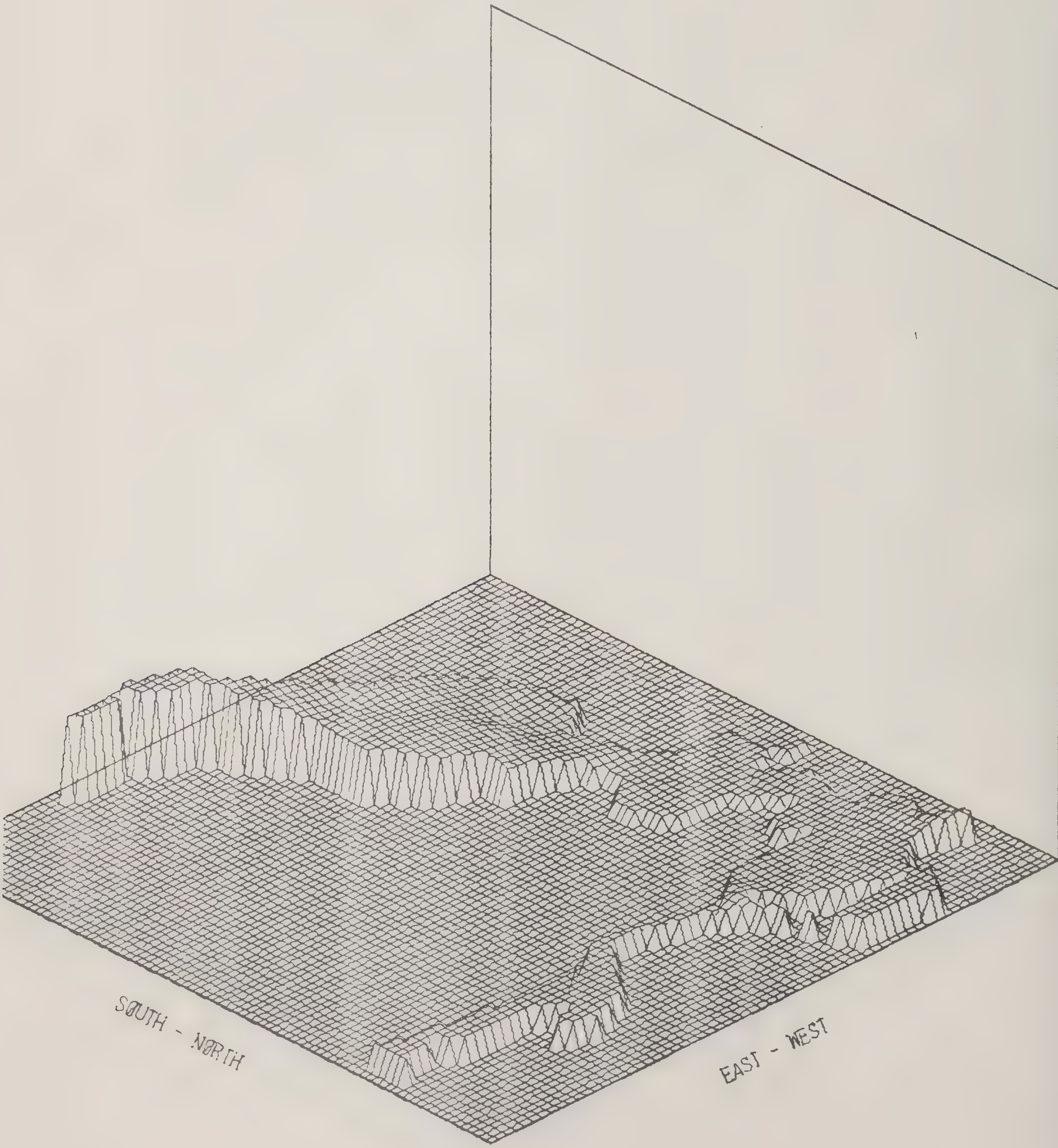




HIGH VALUE = .72 INTERVAL .25

T. PHOSPHORUS(MG/L),2000,SUMMER--BPT

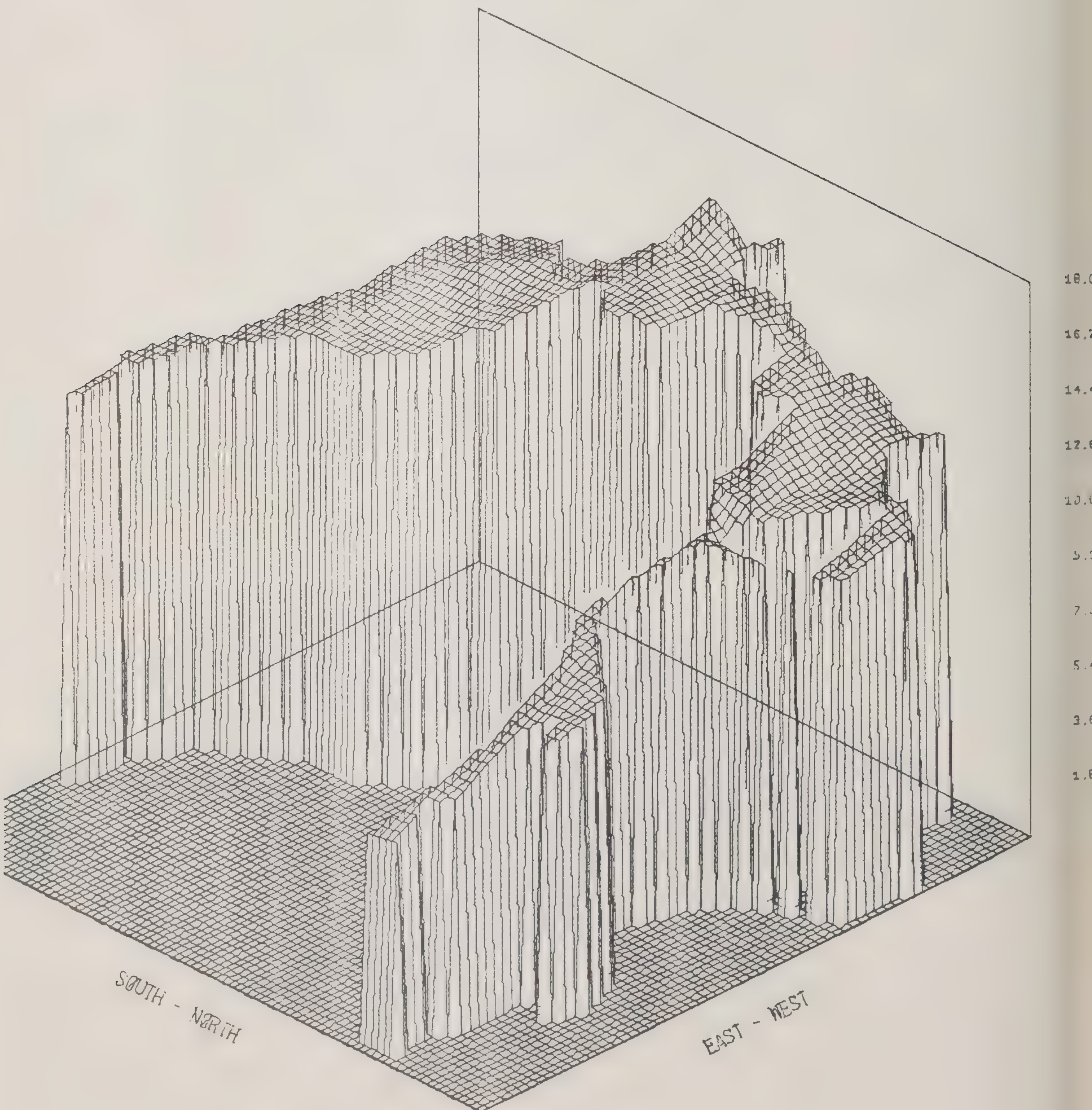
TØT. PHØSPHØRUS(MG/L),2000,SUMMER--BPT

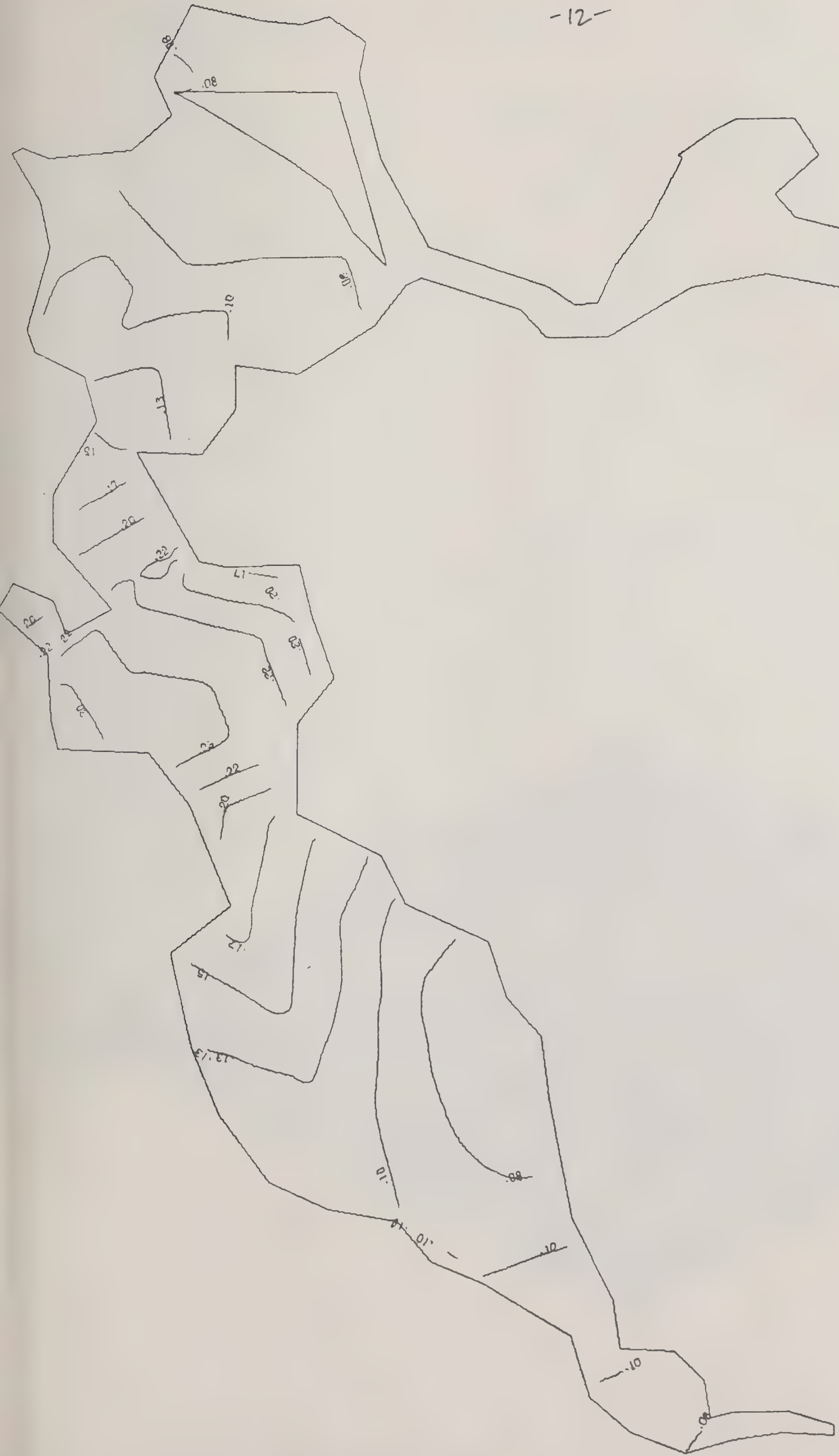


HIGH VALUE = 16.91 INTERVAL 1.00

CHLORIDES/1000 (MG/L),2000,SUMMER--BPT

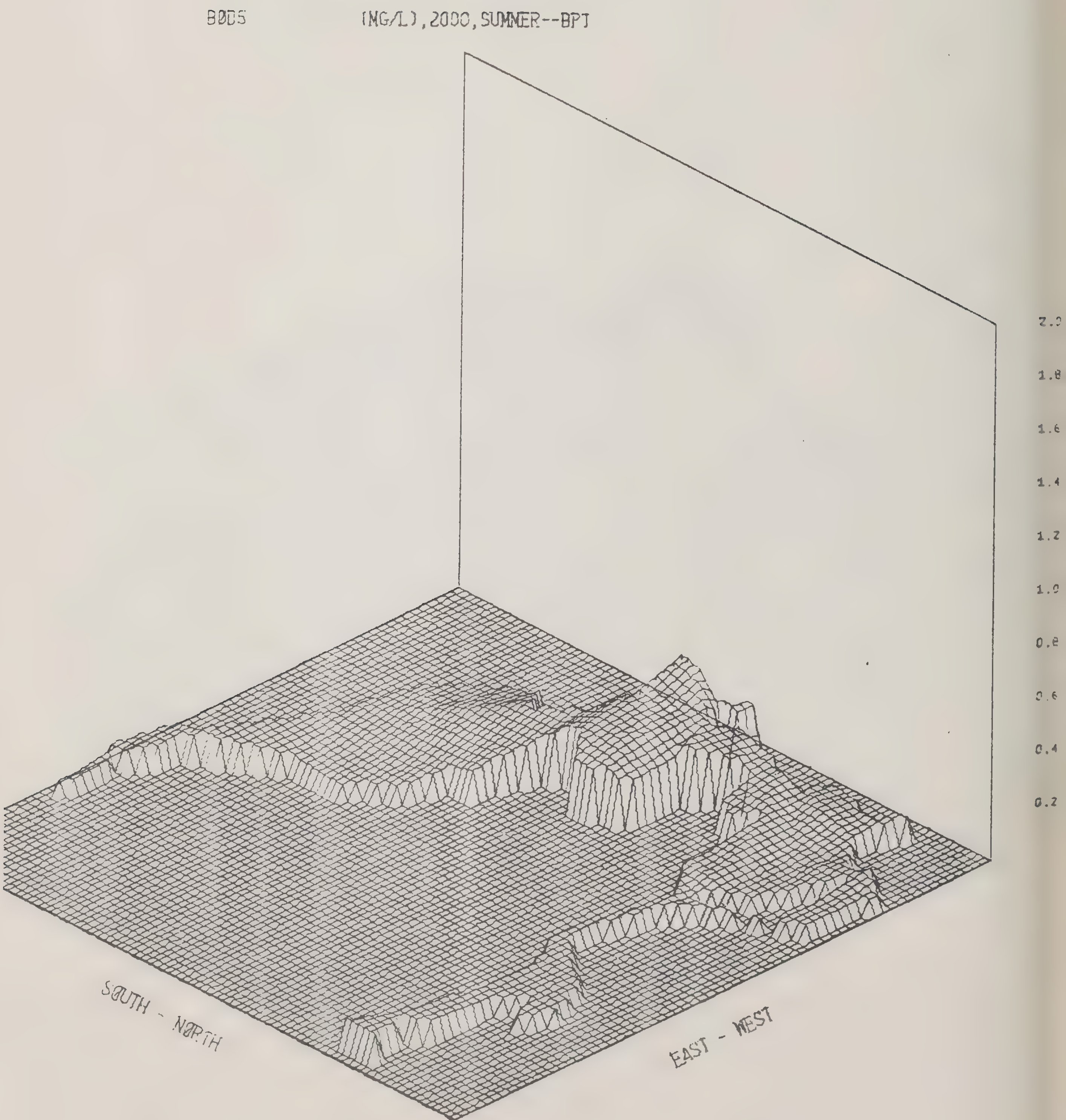
CHLØRIDES/1000 (MG/L),2000,SUMMER--BPT

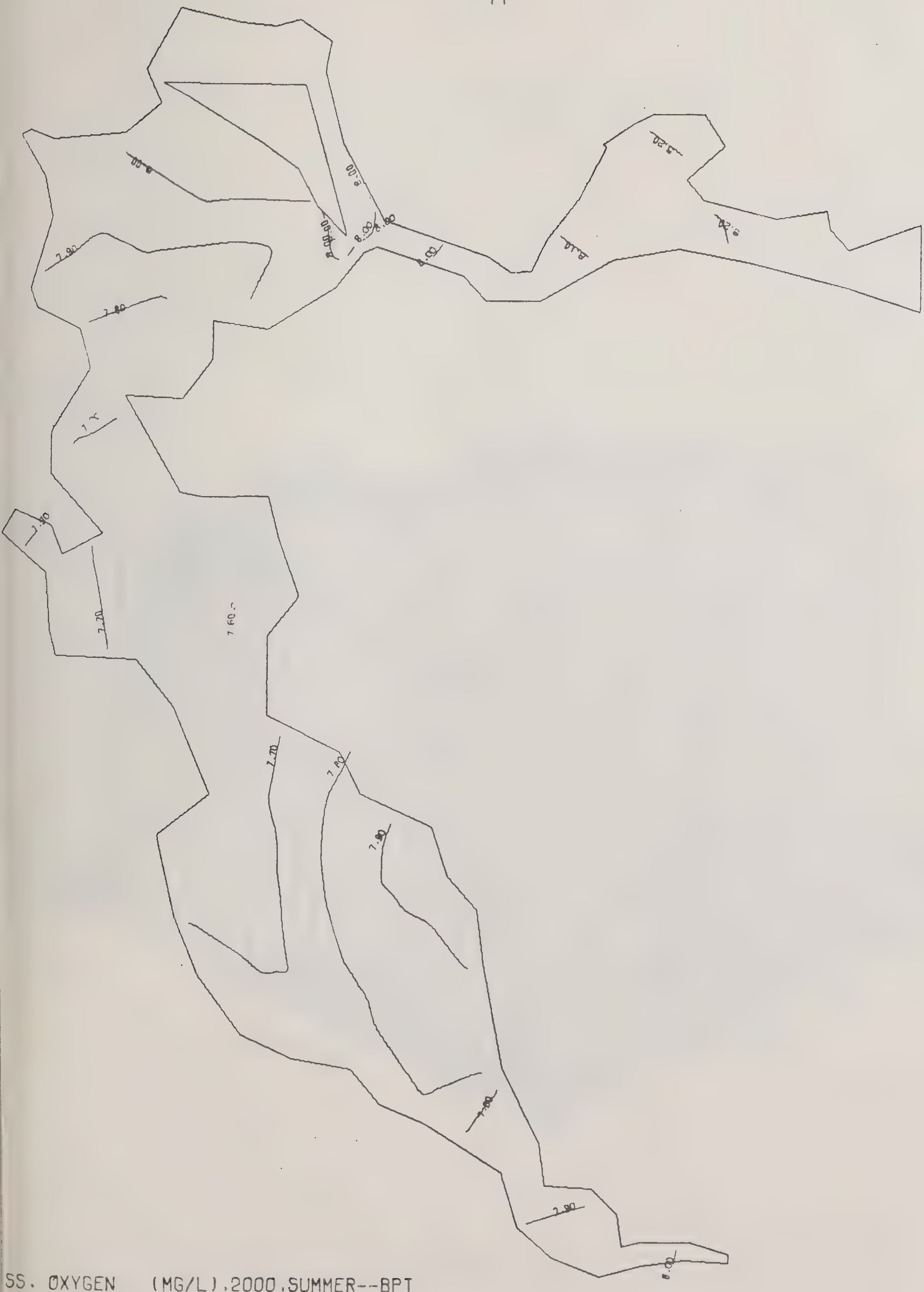




HIGH VALUE = .33 INTERVAL .05

(MG/L),2000,SUMMER--BPT

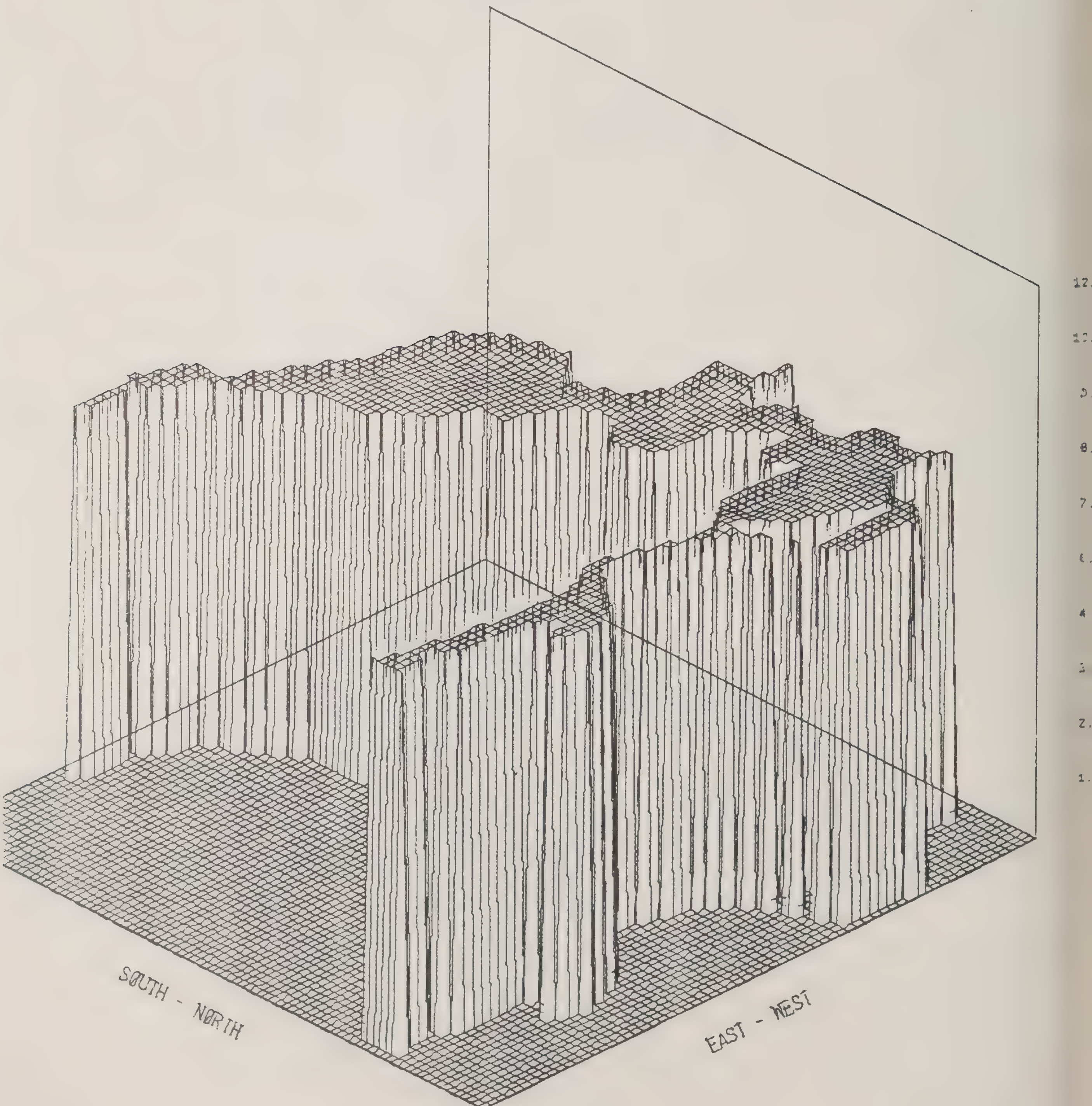

BØD5 (MG/L),2000,SUMMER--BPT
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
SØUTH - NØRTH
EAST - WEST

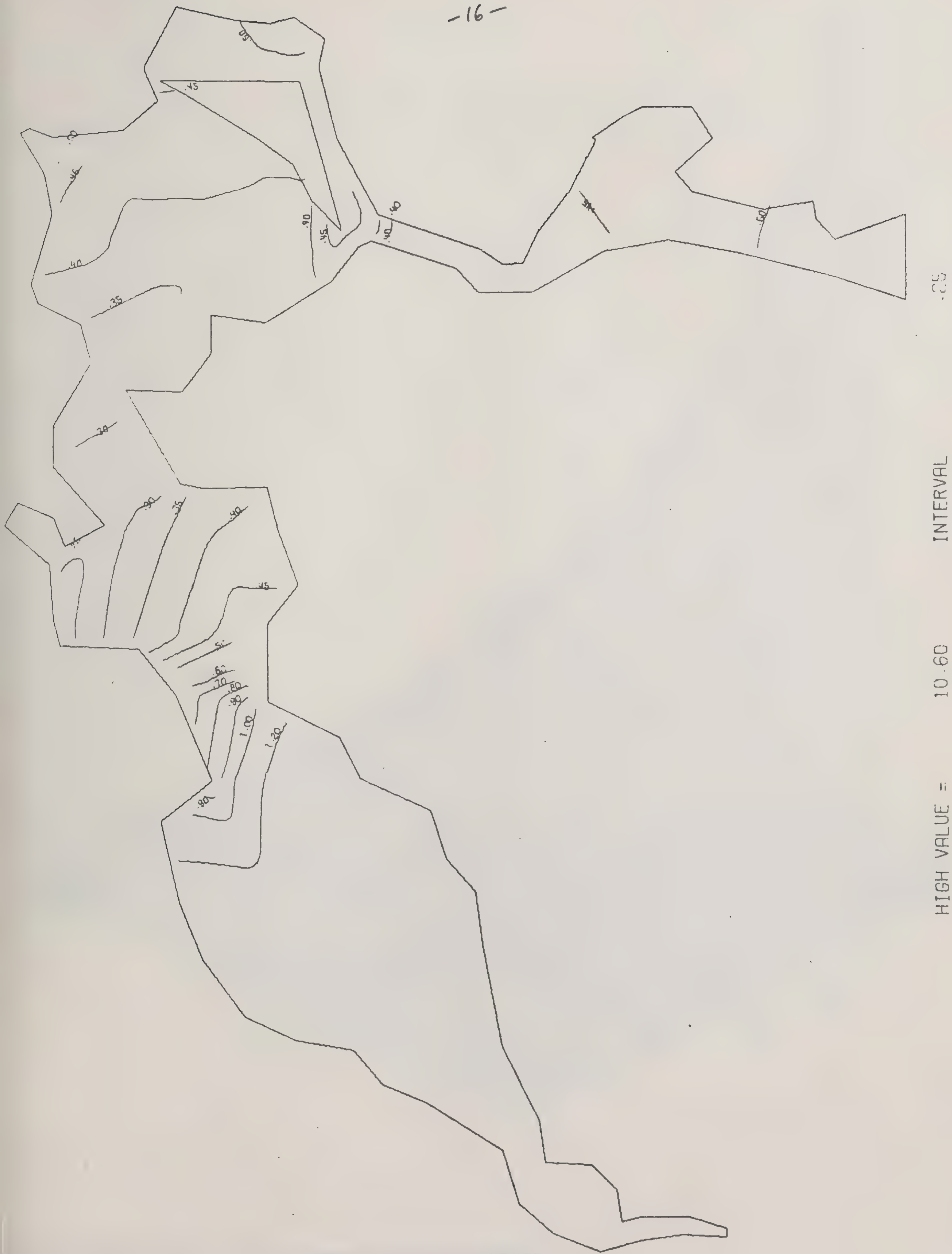


HIGH VALUE = 8.27 INTERVAL .10

SS. OXYGEN (MG/L).2000.SUMMER--BPT

DISS. ØXYGEN (MG/L),2000,SUMMER--BPT





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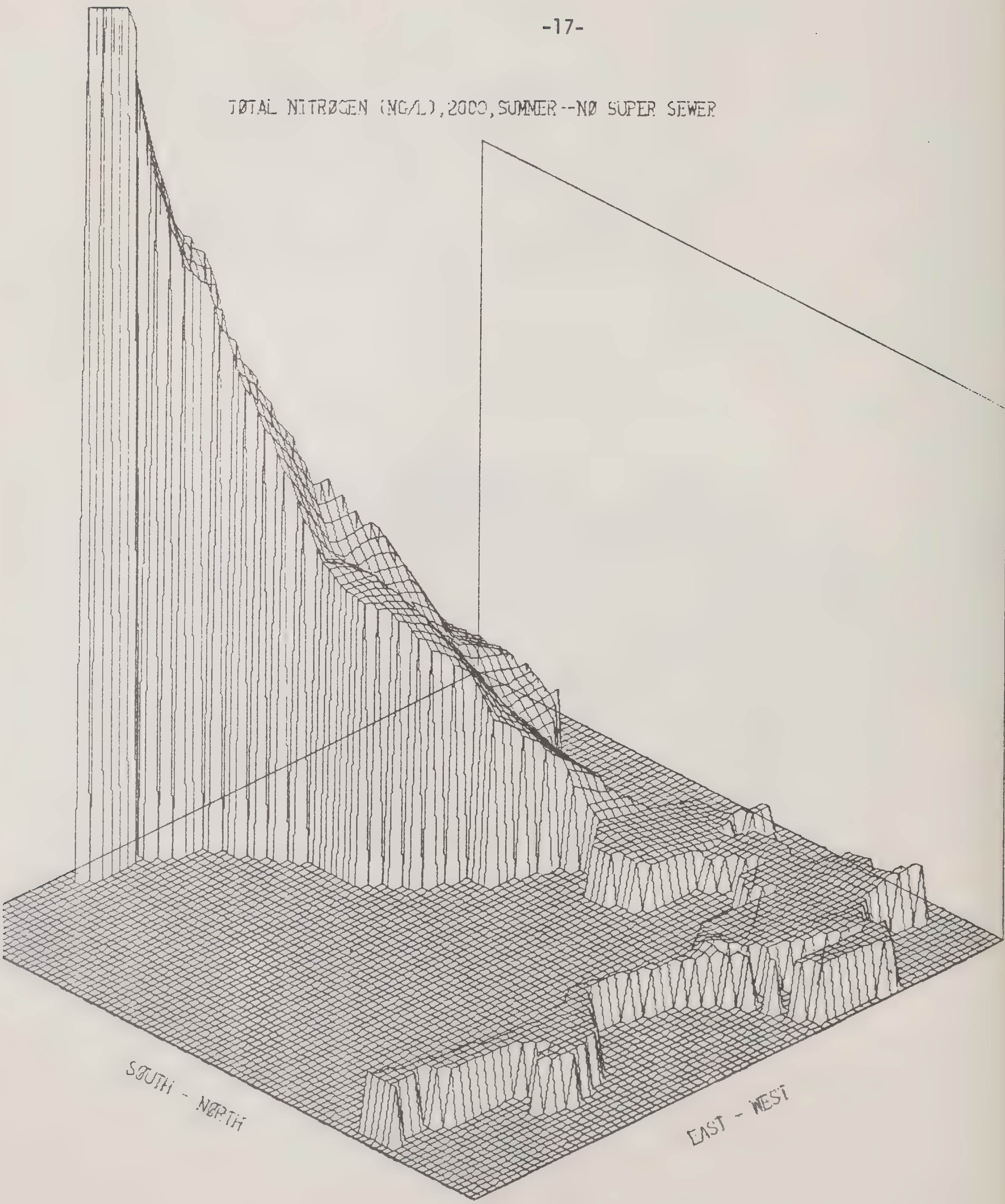

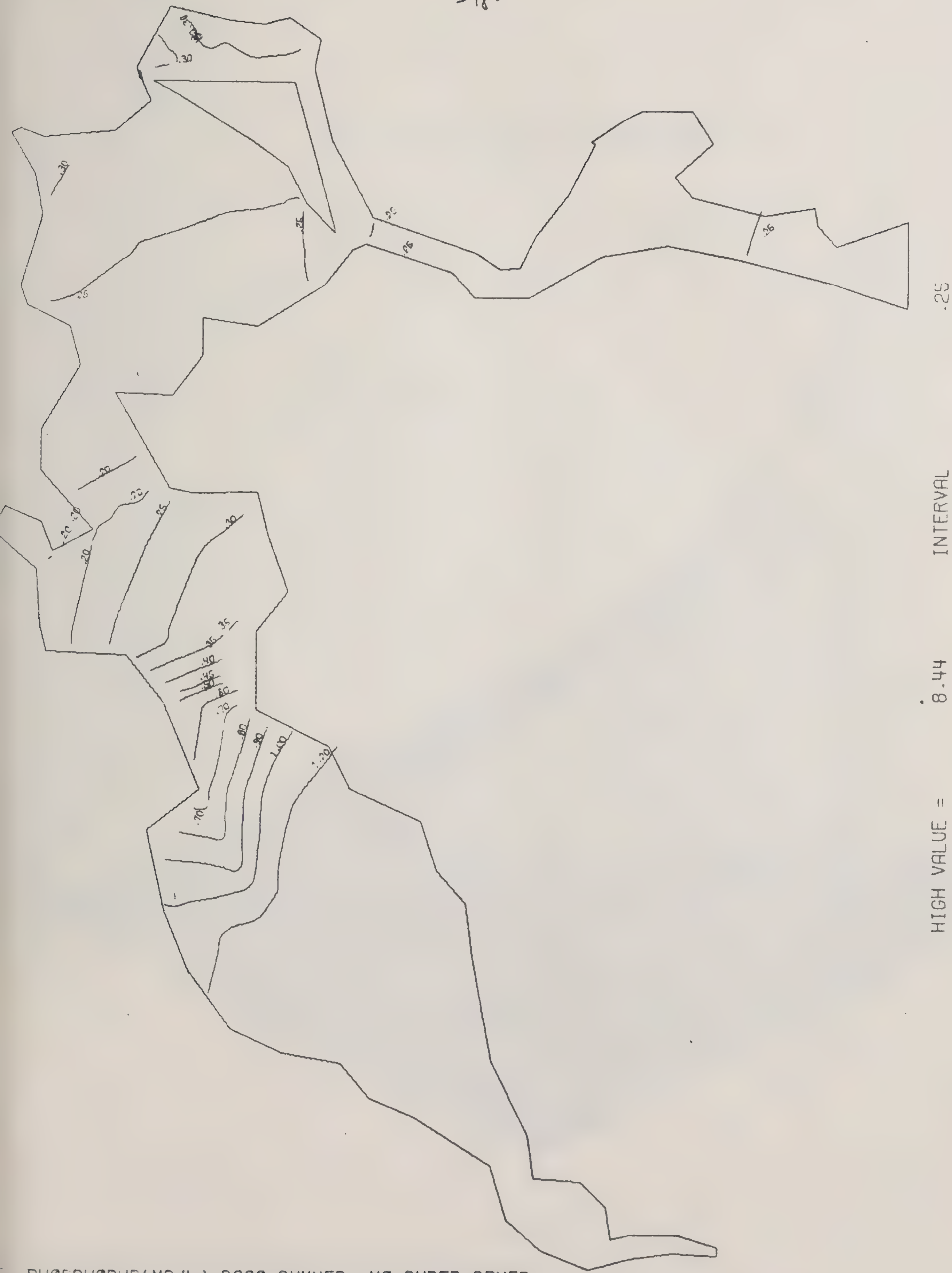

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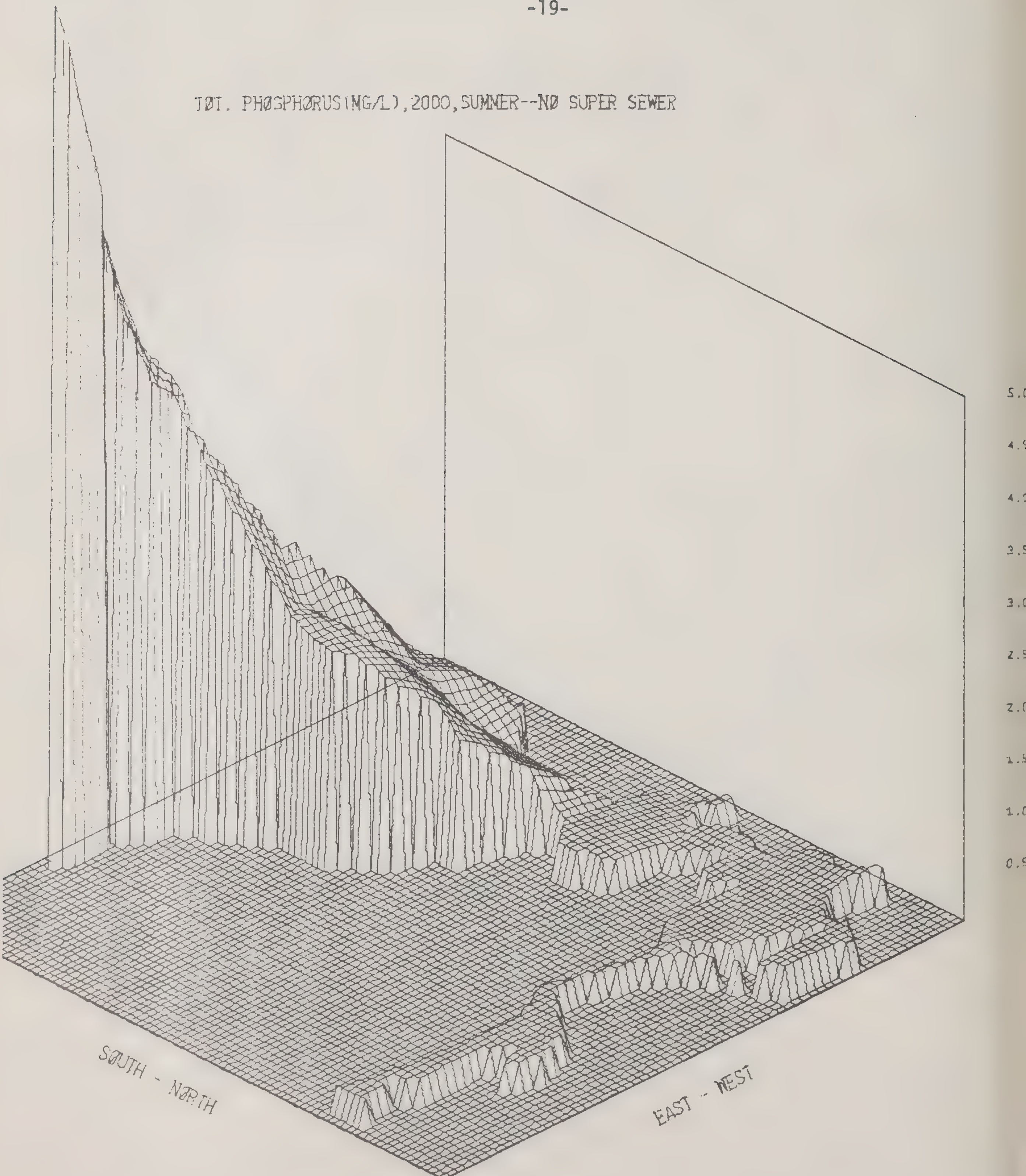

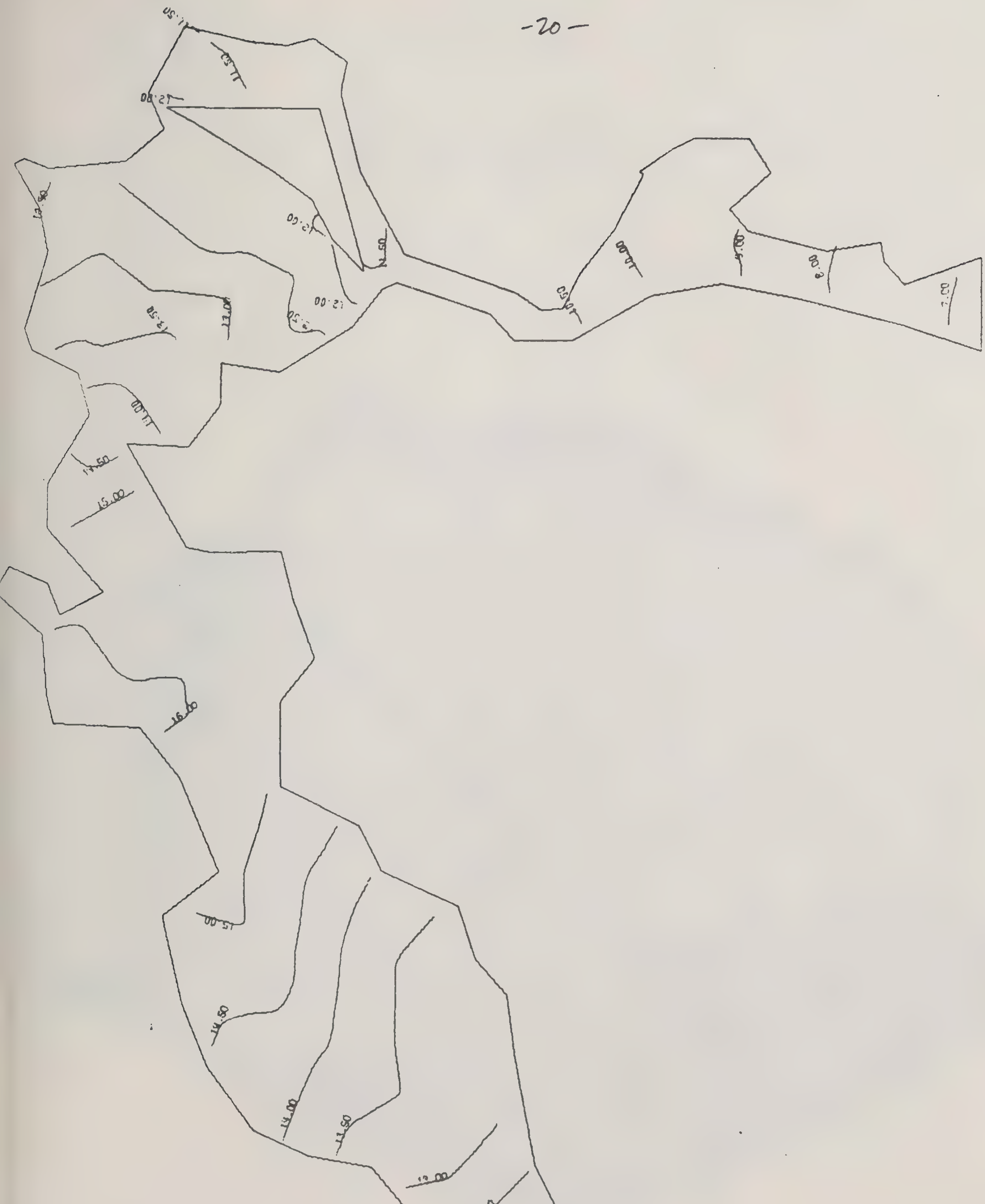

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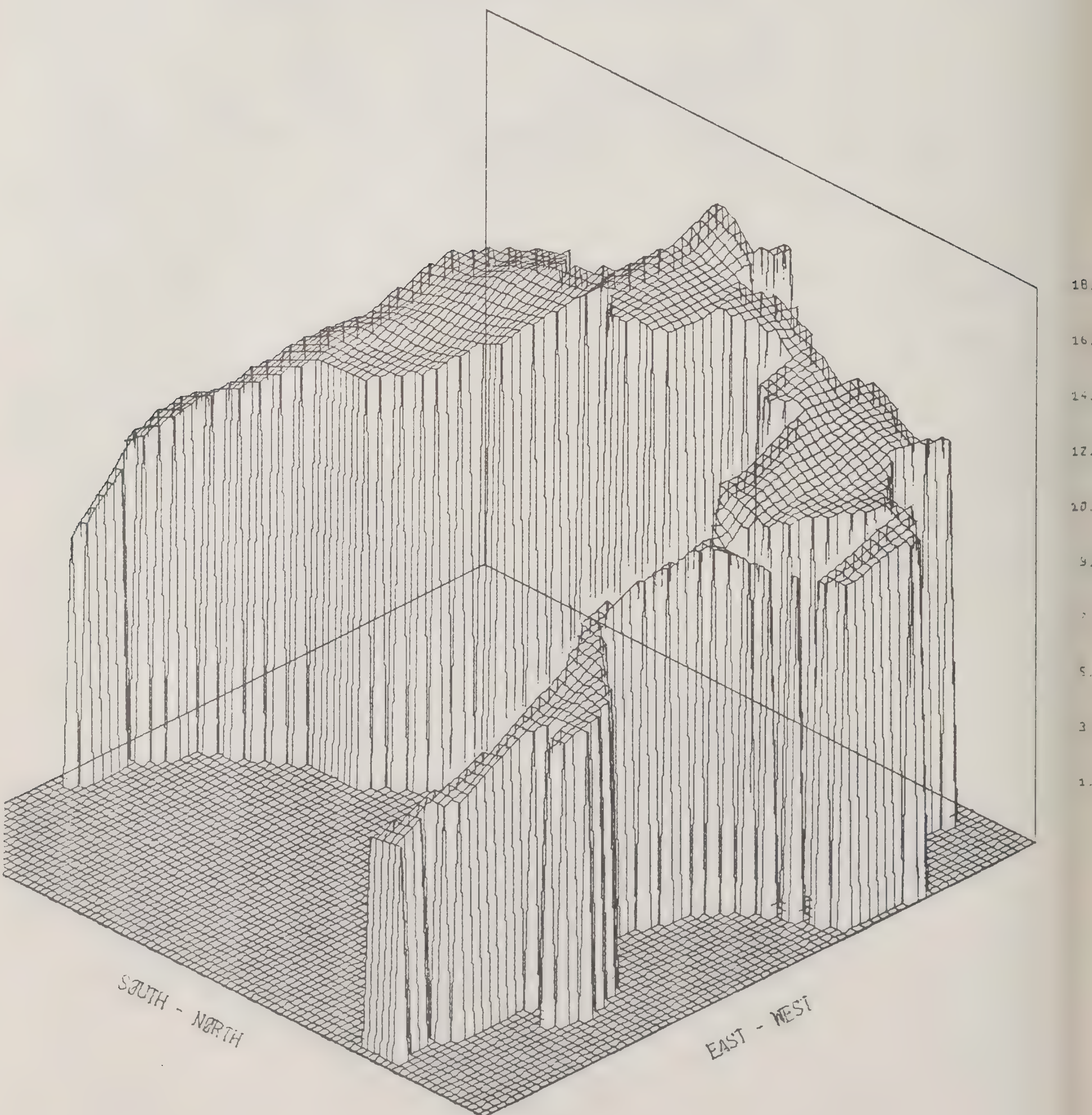

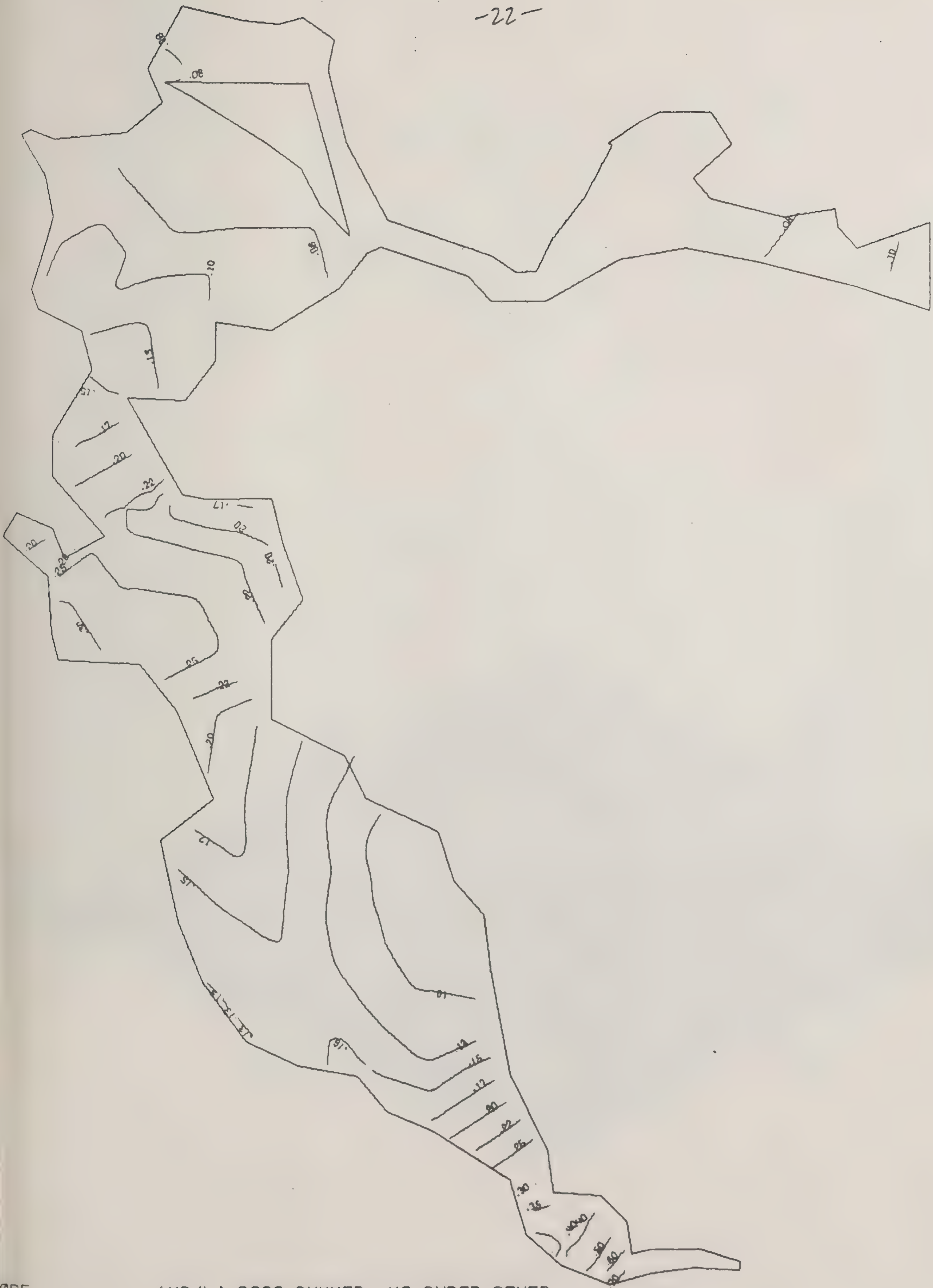

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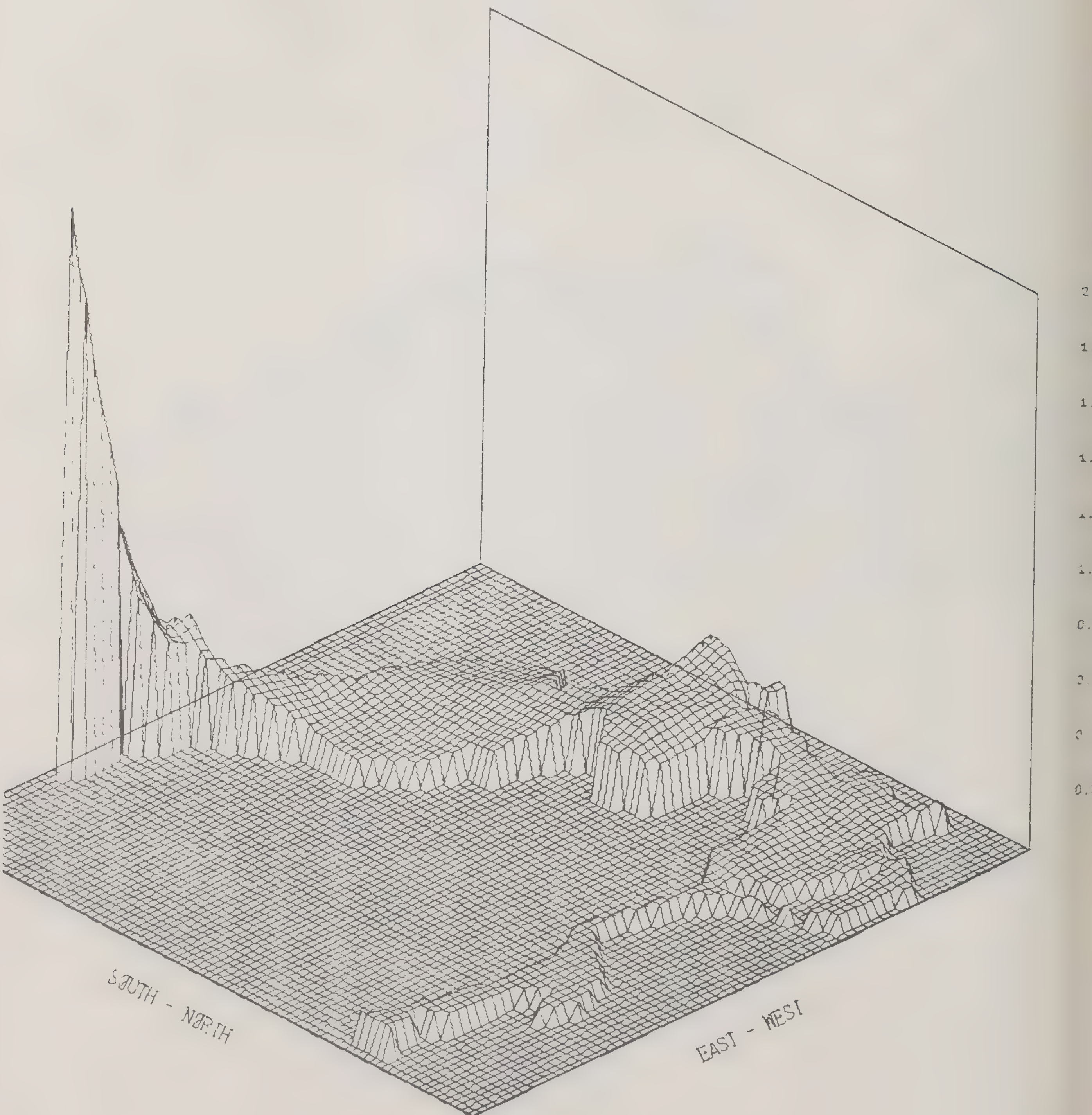
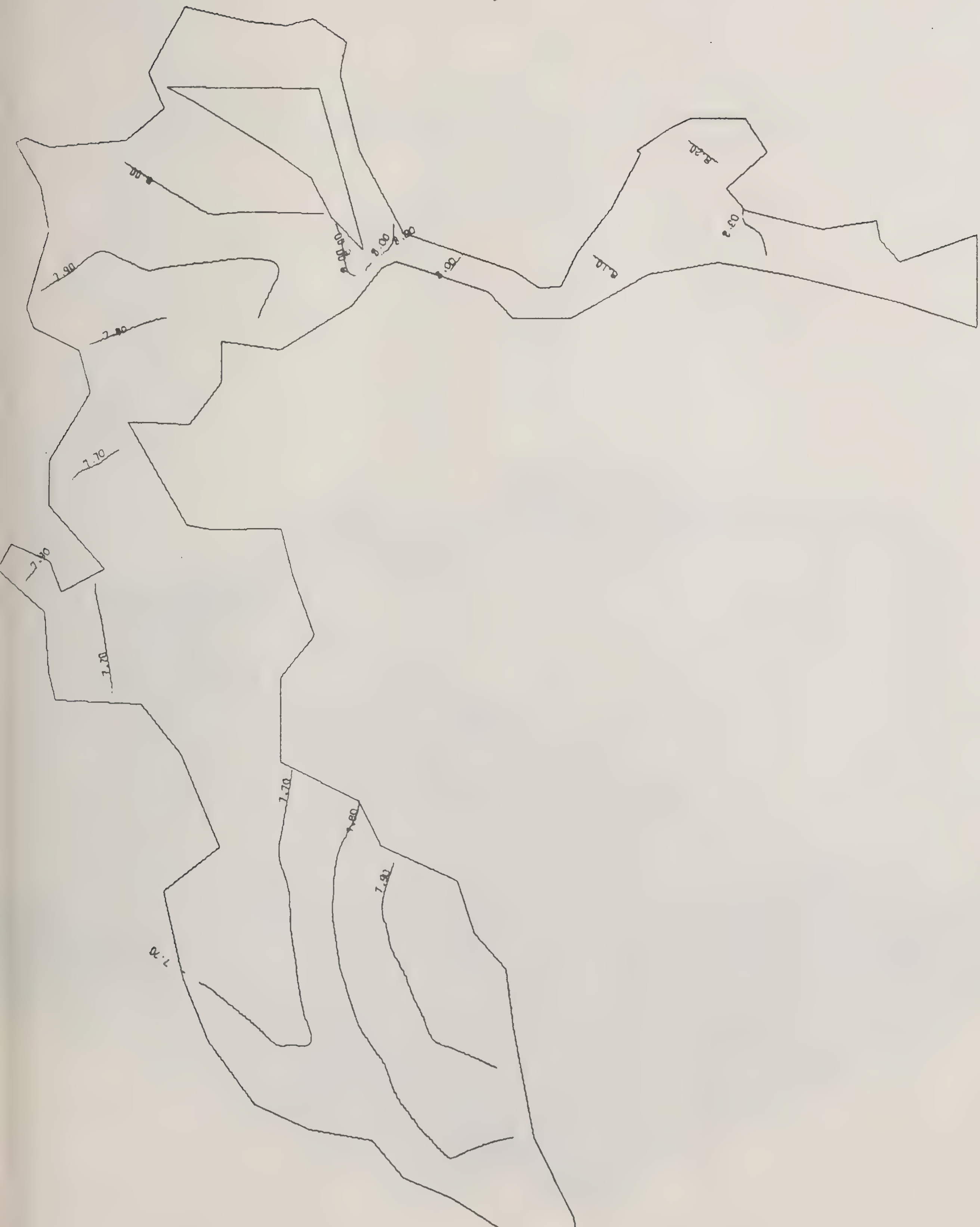
BØD5 (MG/L),2000,SUMMER--NØ SUPER SEWER





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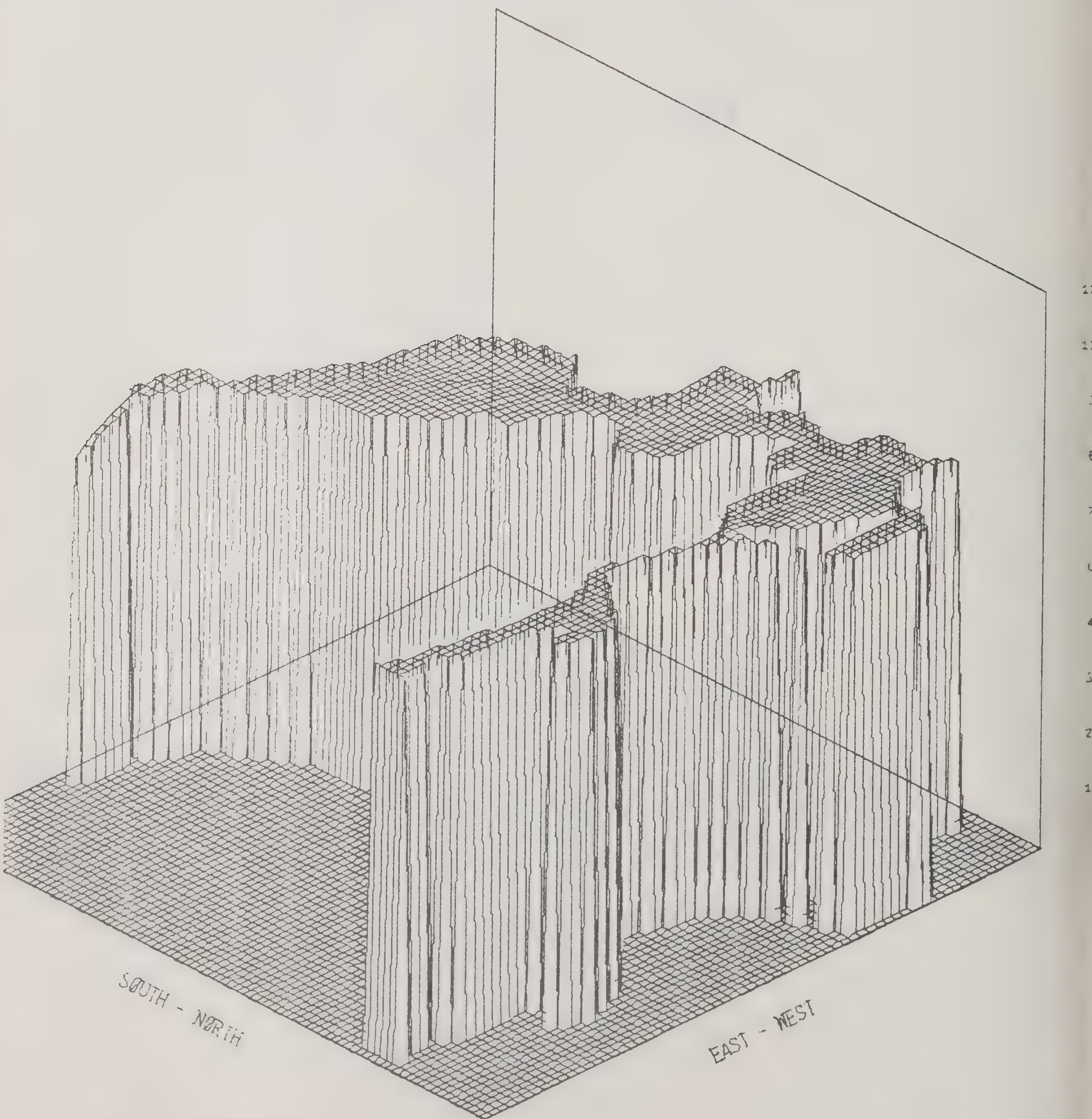
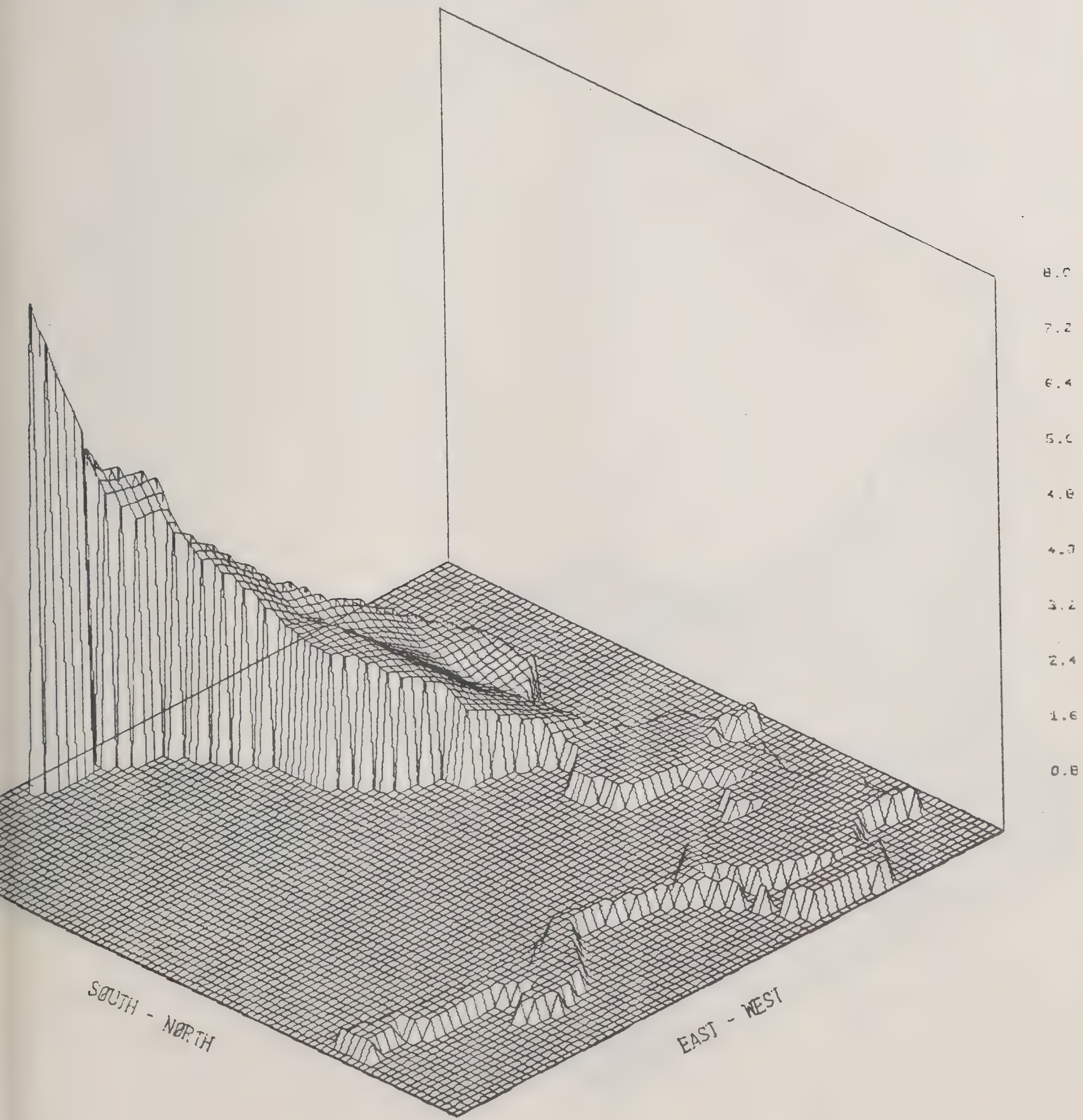
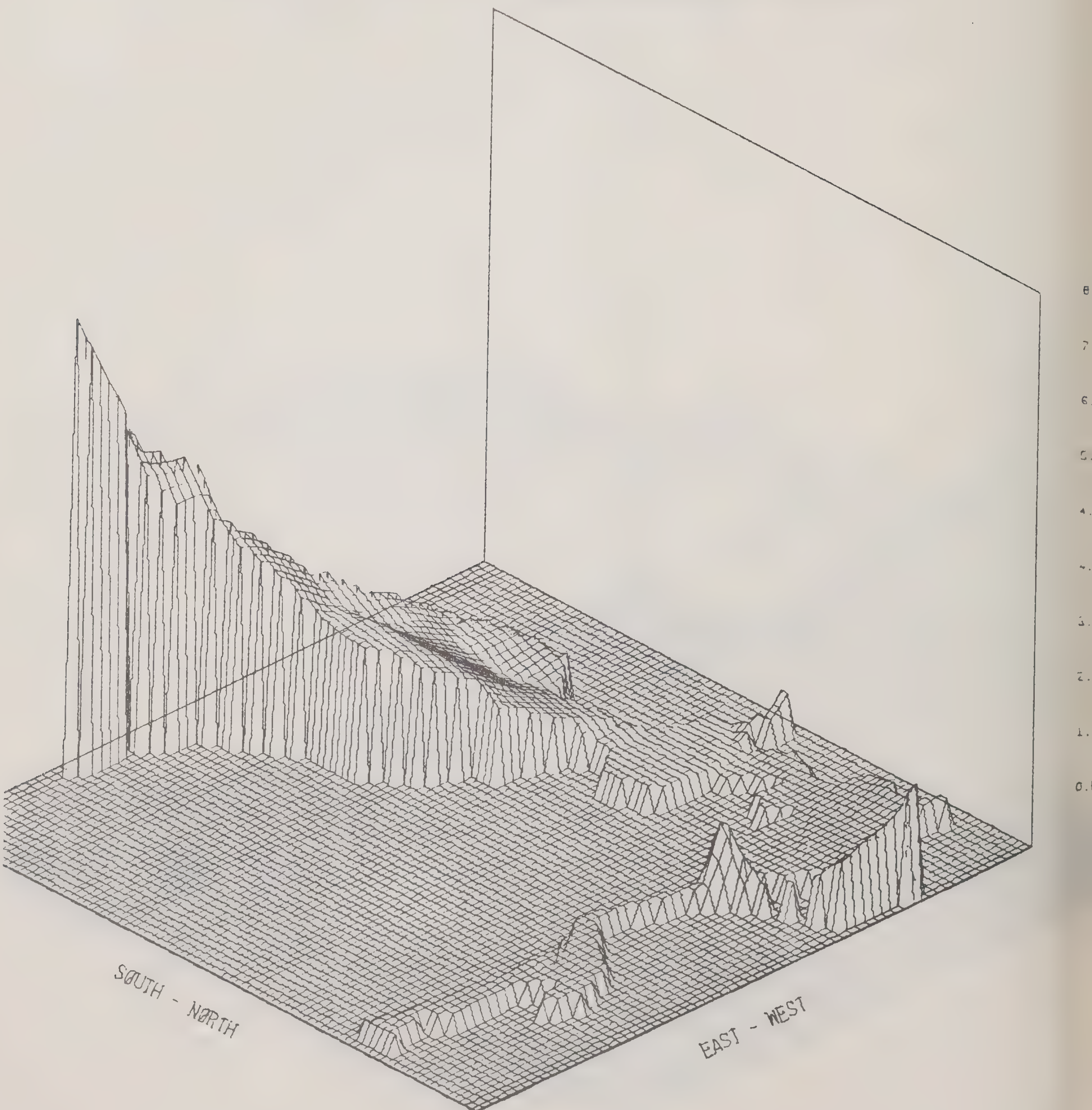


TØTAL NITRØGEN, 1975, DAY BEFØRE STØRM



TØTAL NITRØGEN, 1975, DAY 1 ØF STØRM



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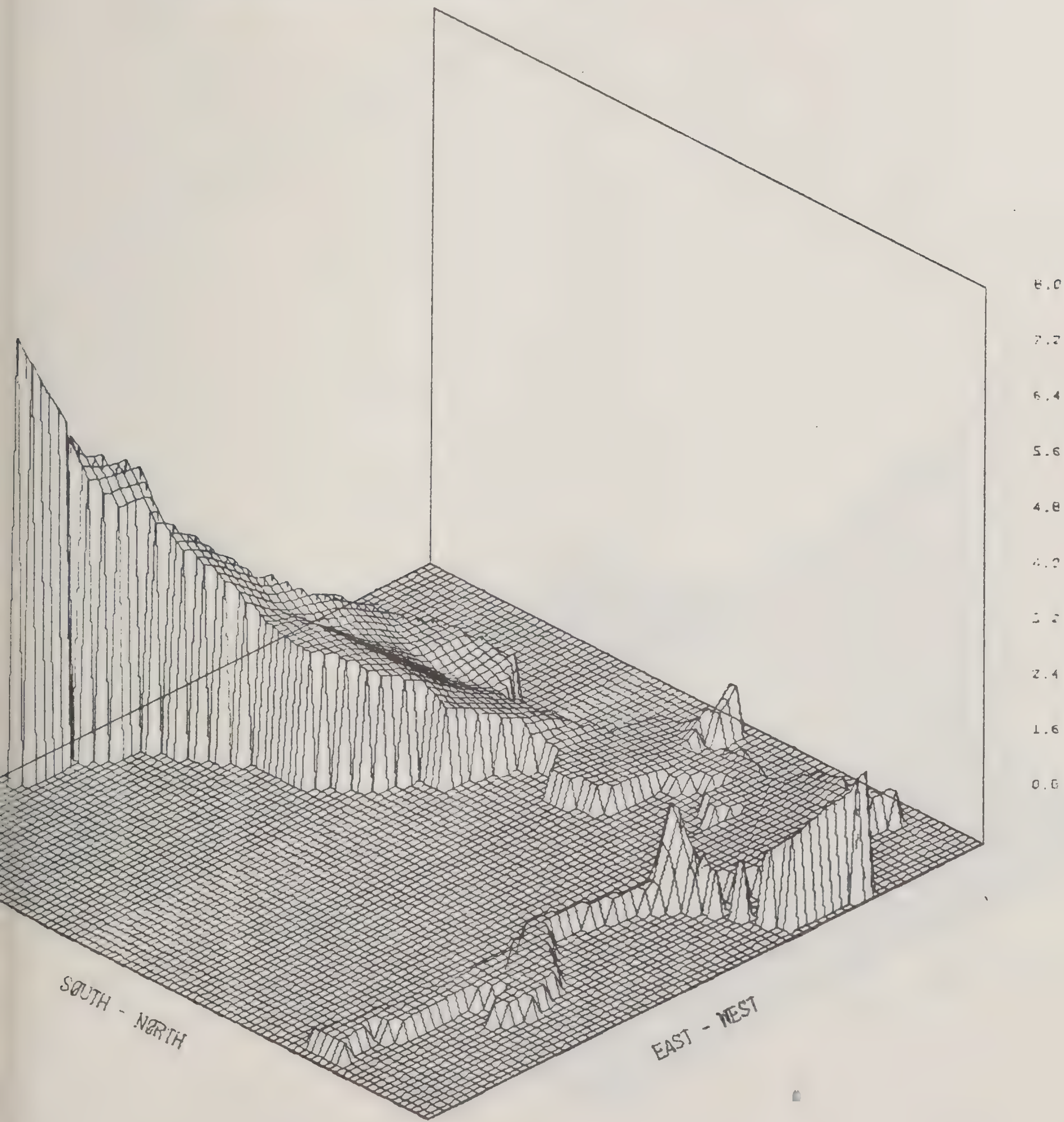

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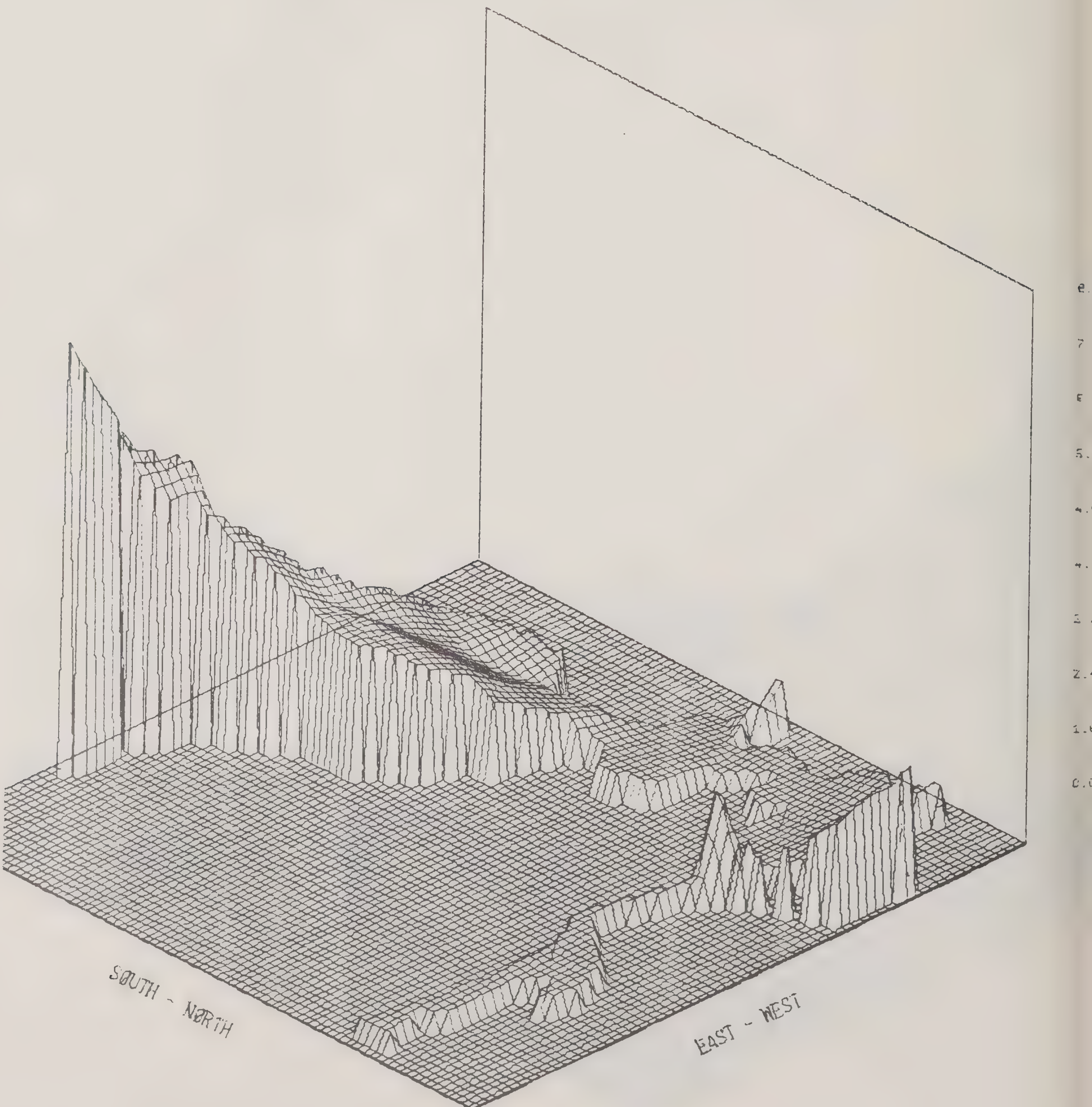

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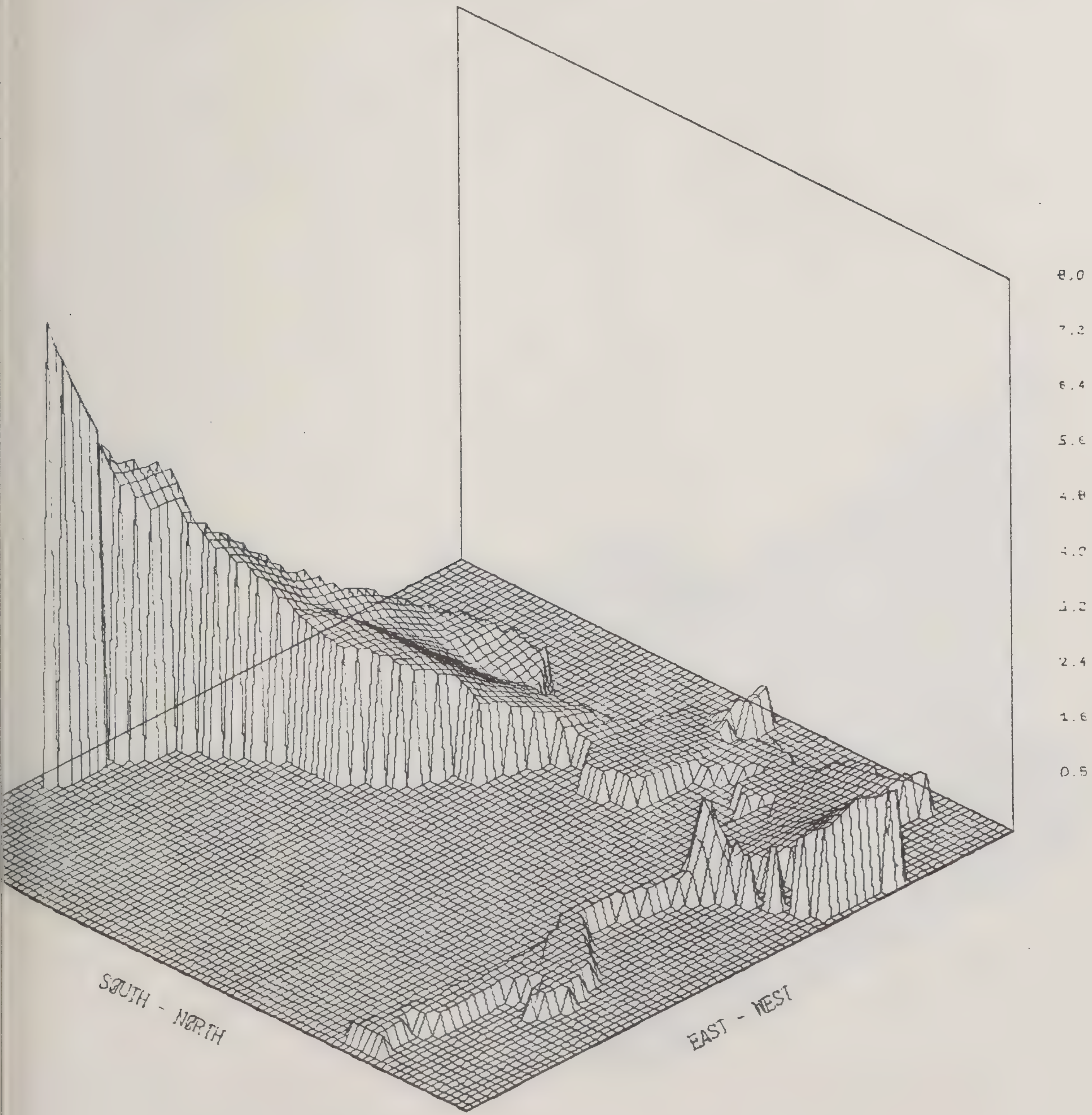

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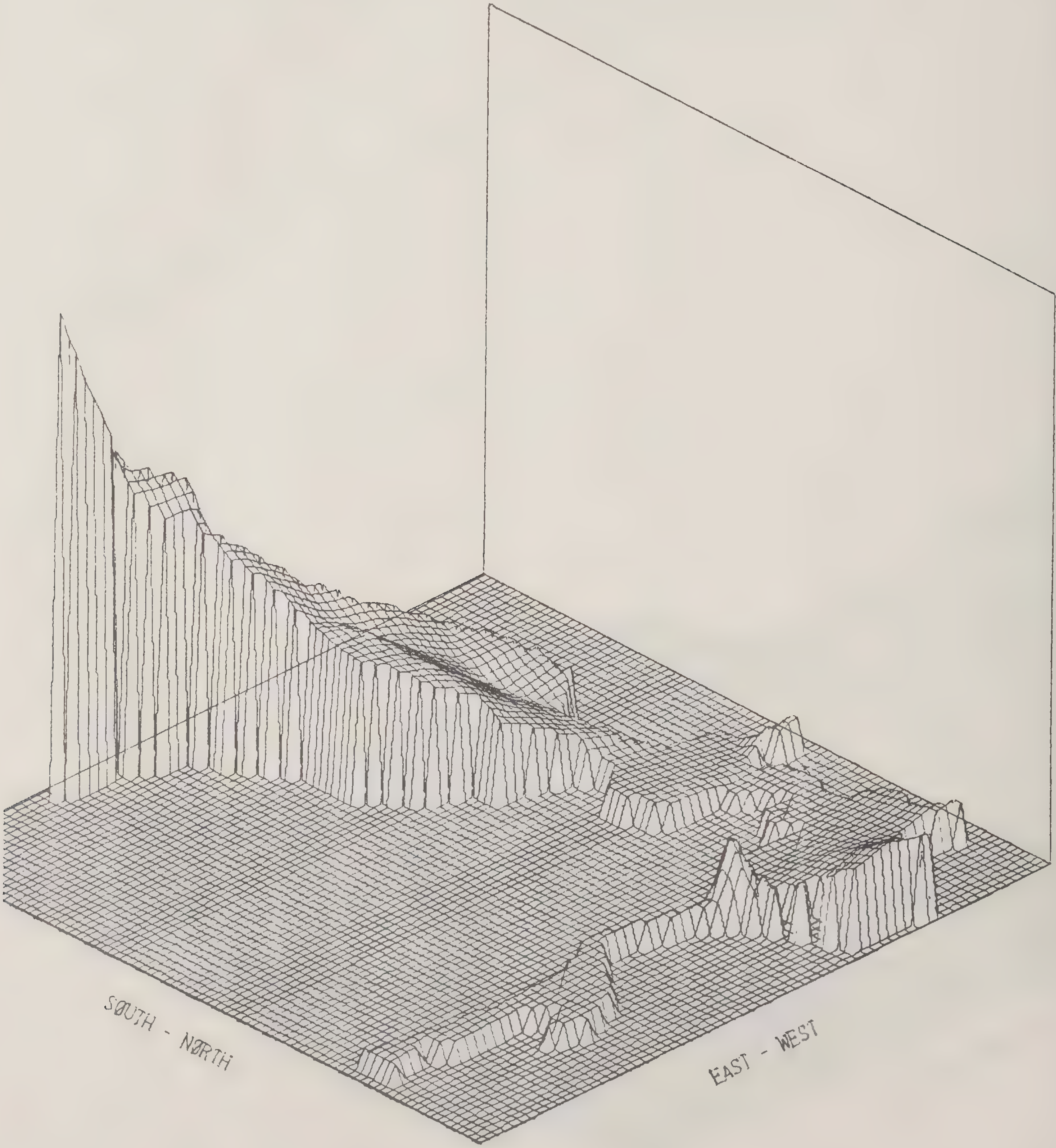

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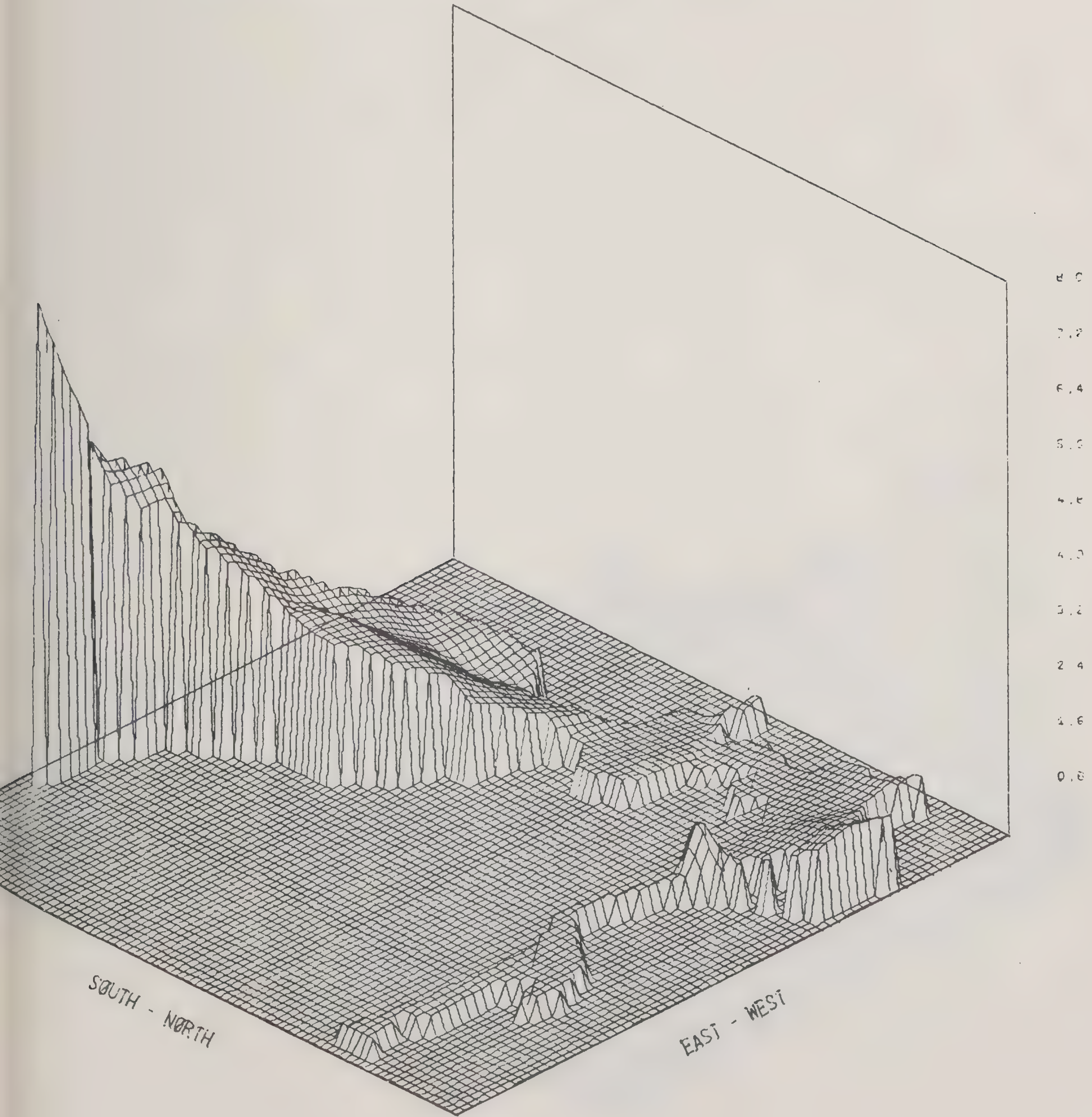

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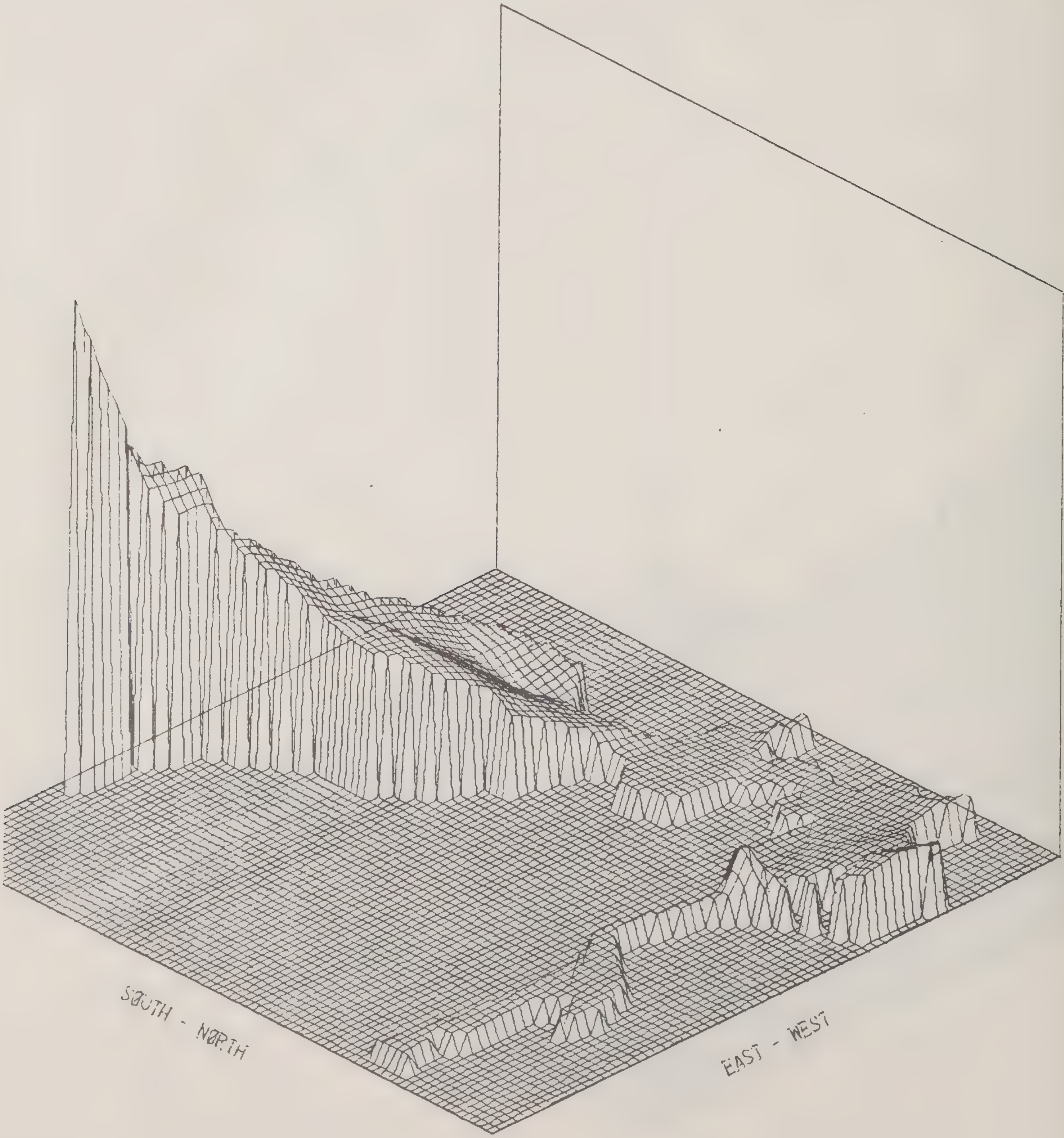
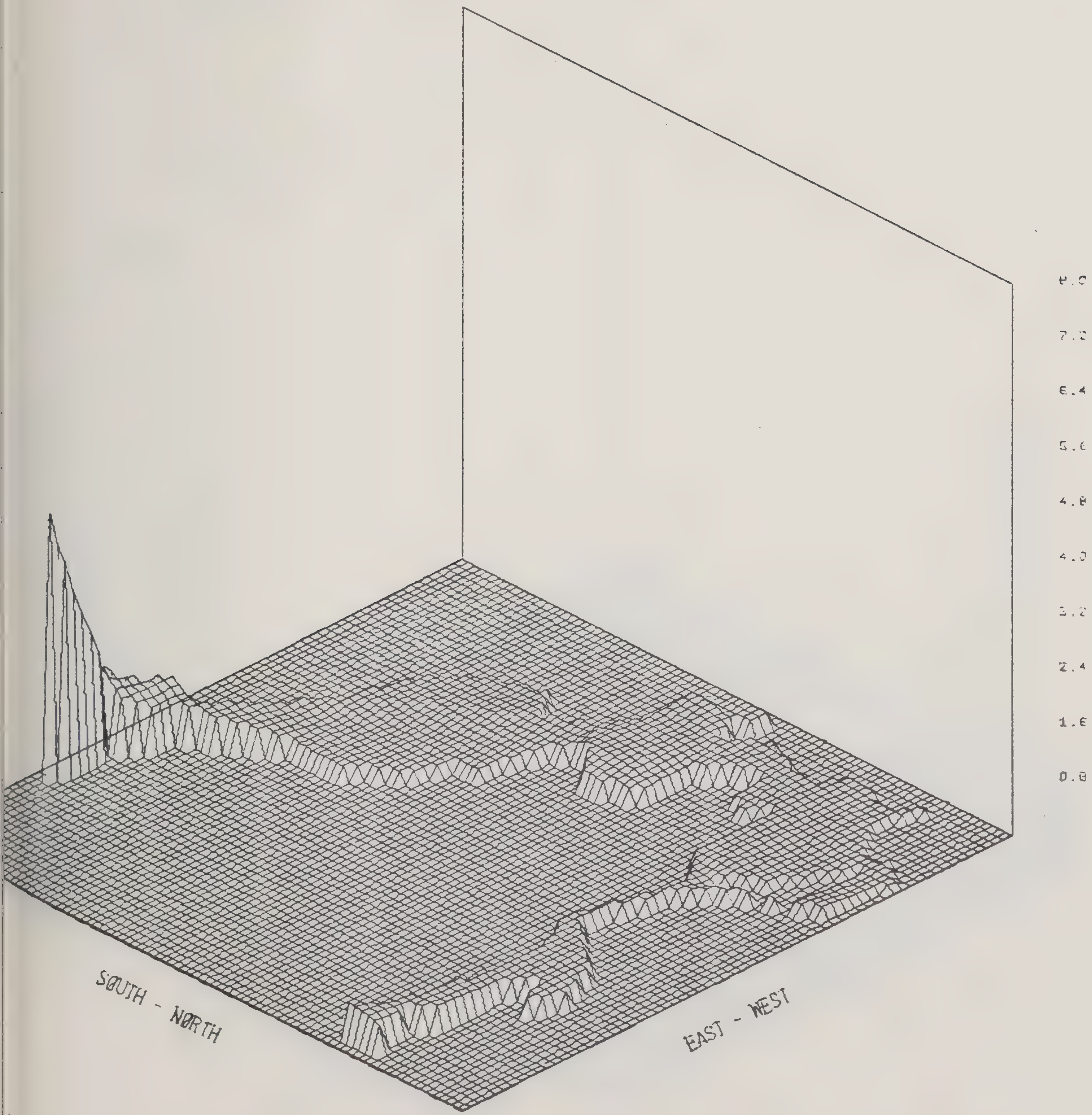
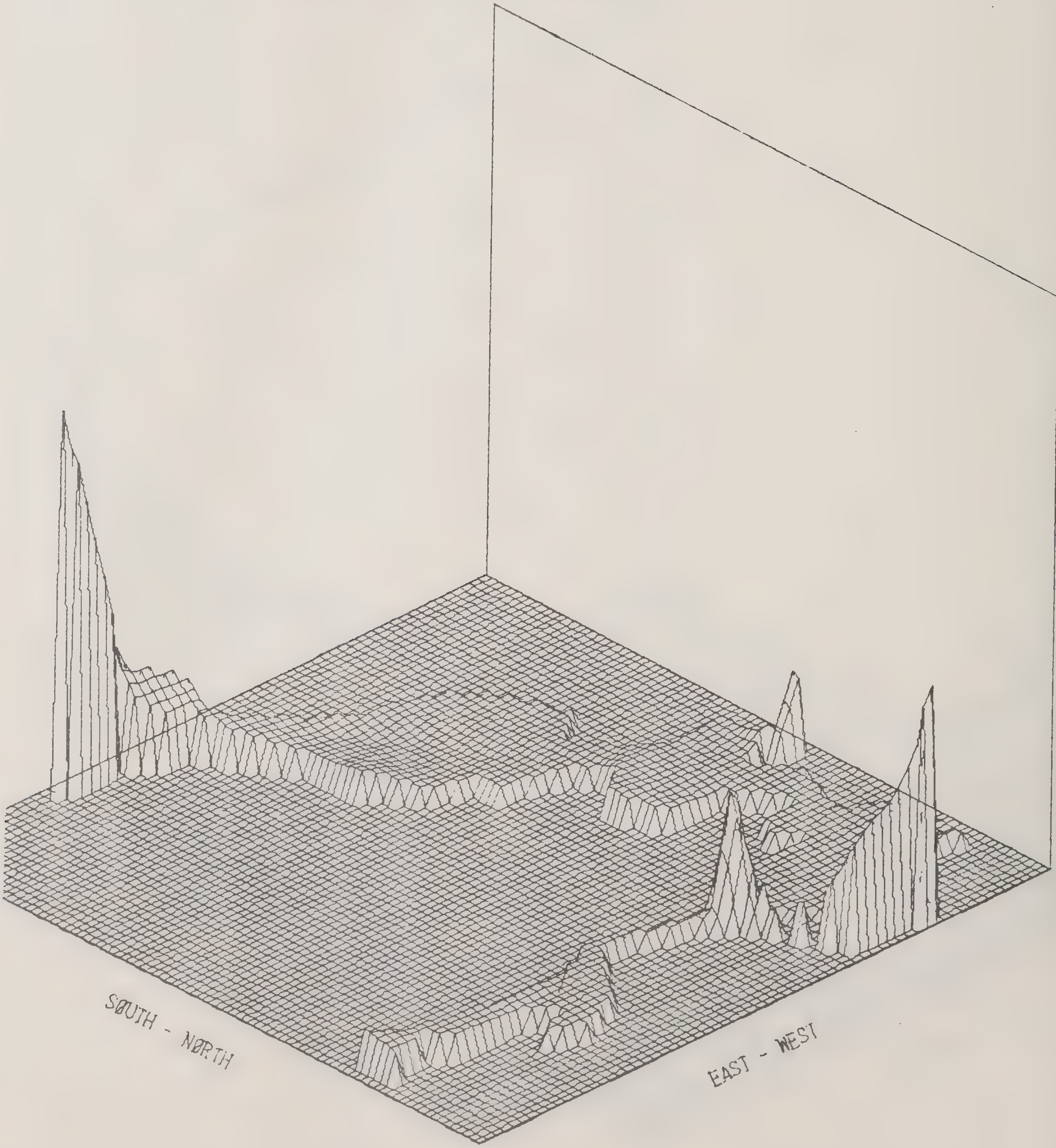


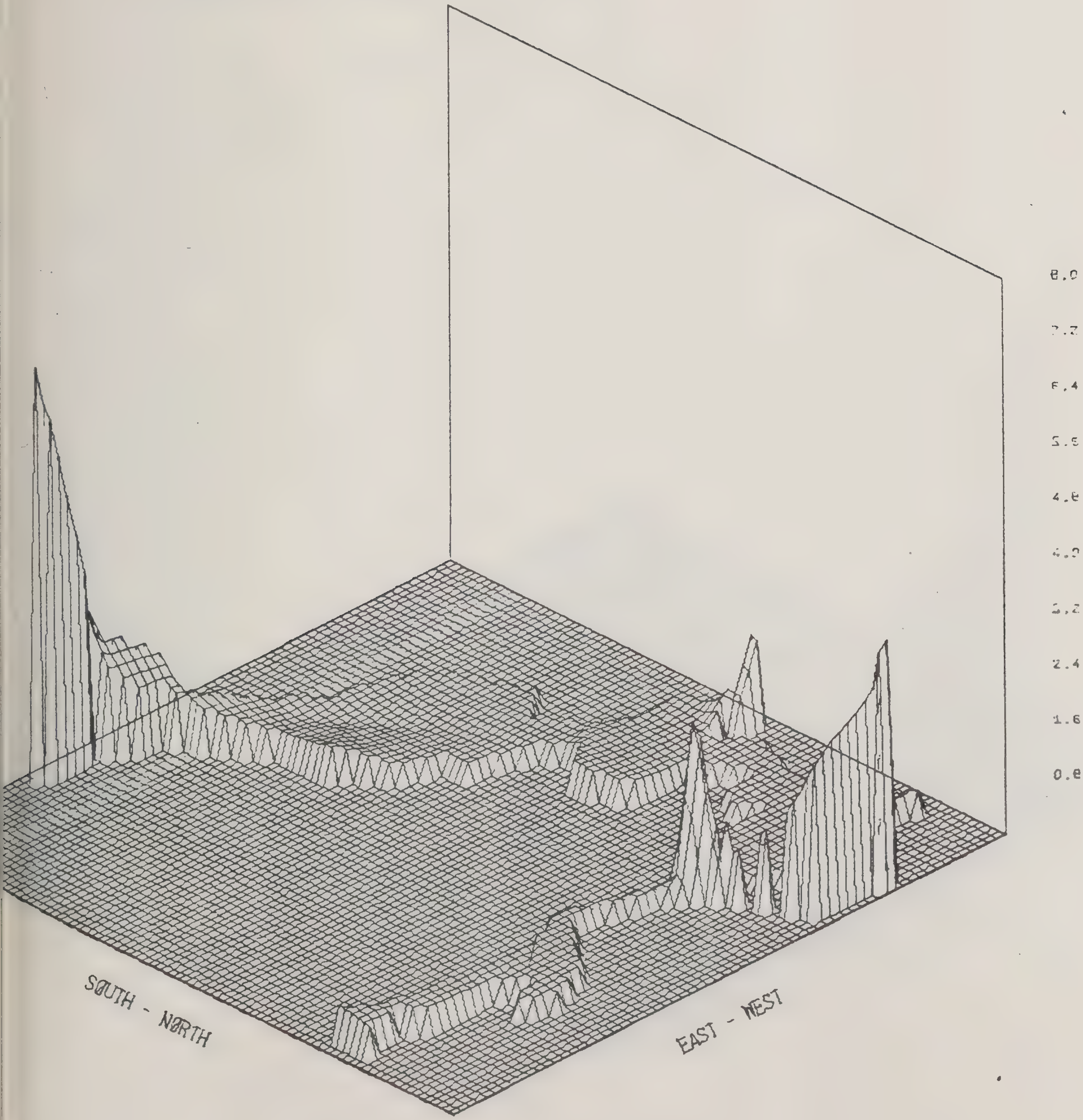
BØØ5,1975,DAY BEFØRE STØRM



E2DS, 1976, DAY 1 ØF STØRM



BØD5,1975,DAY 2 ØF STØRM



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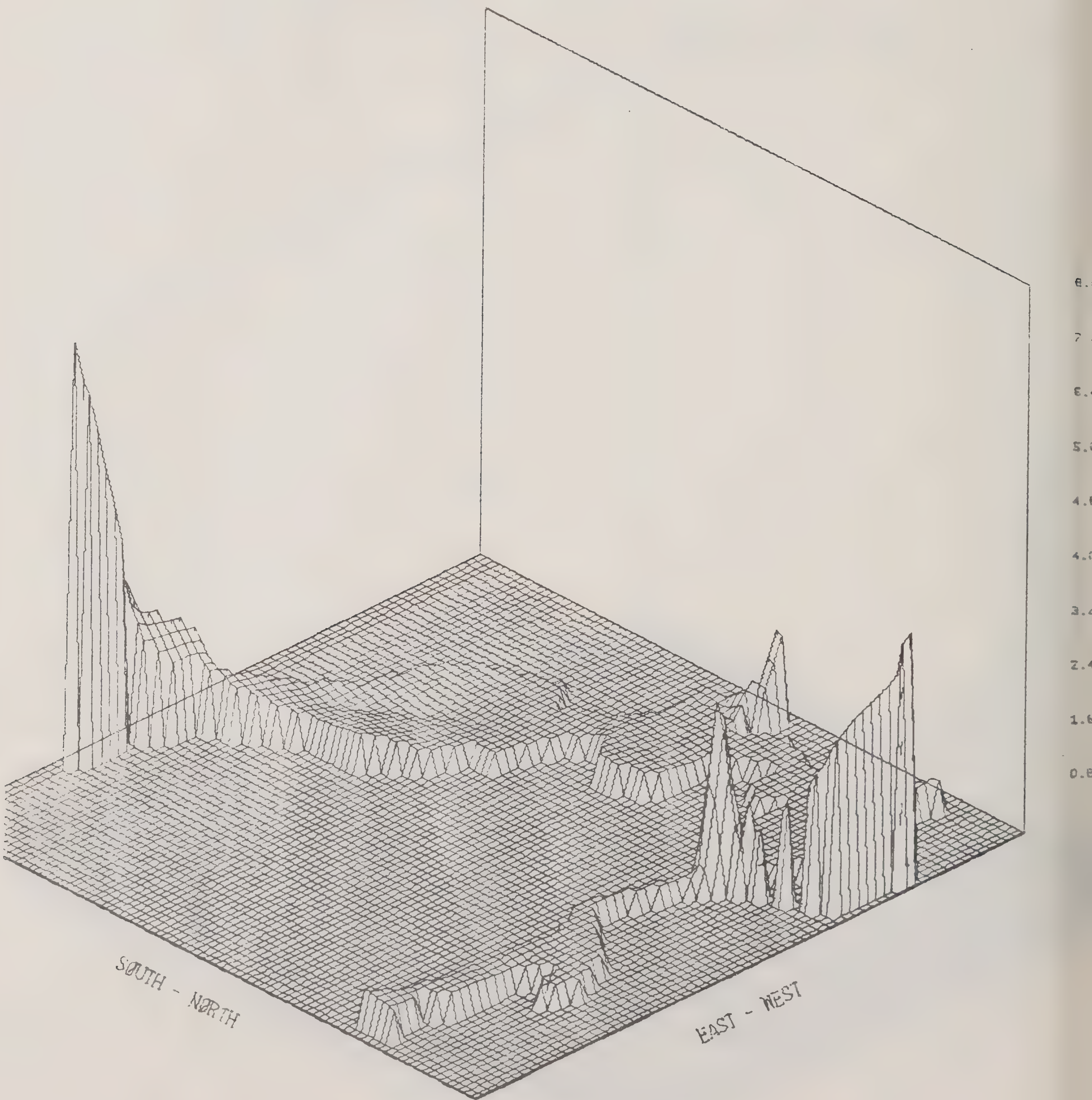

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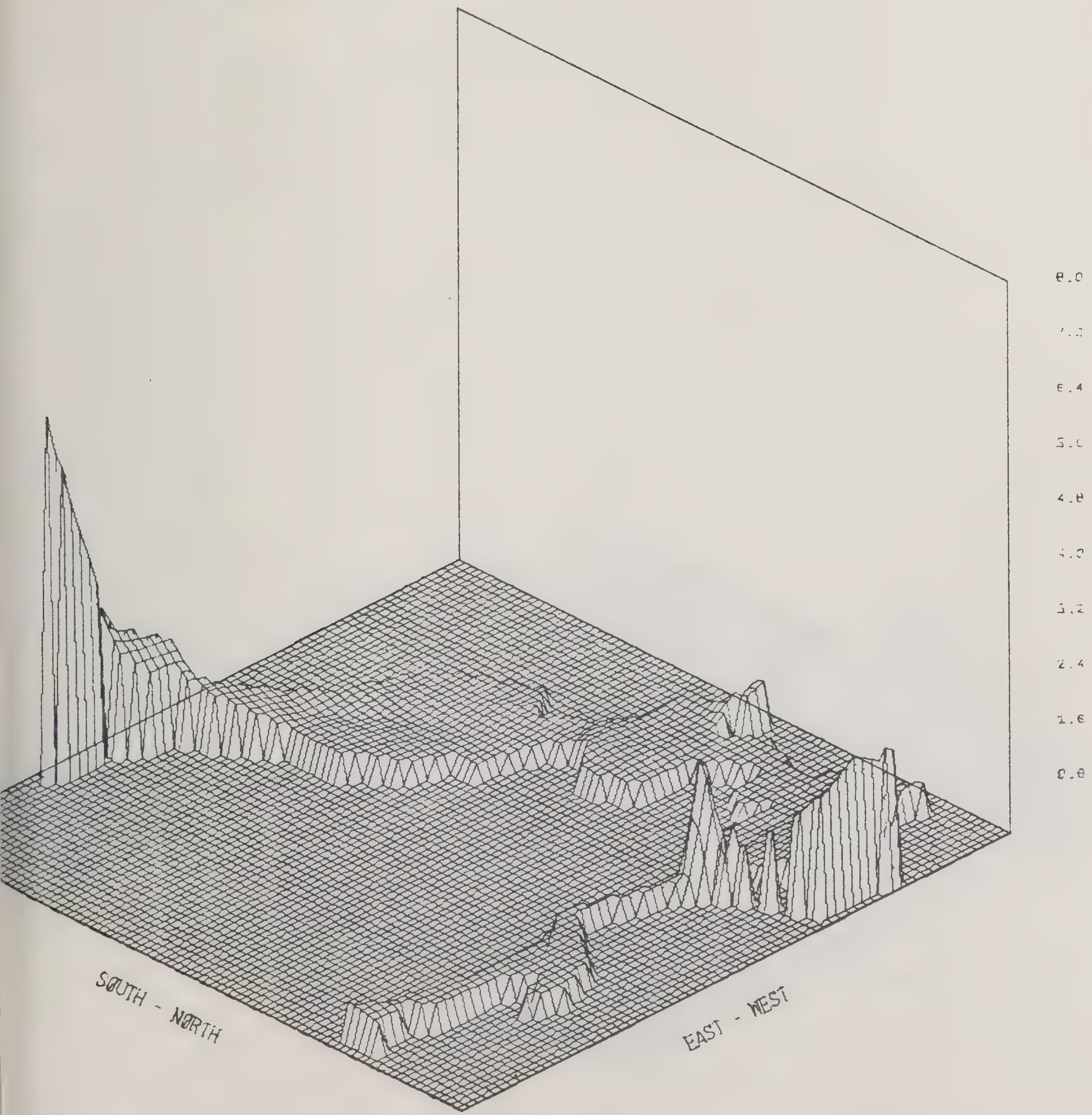

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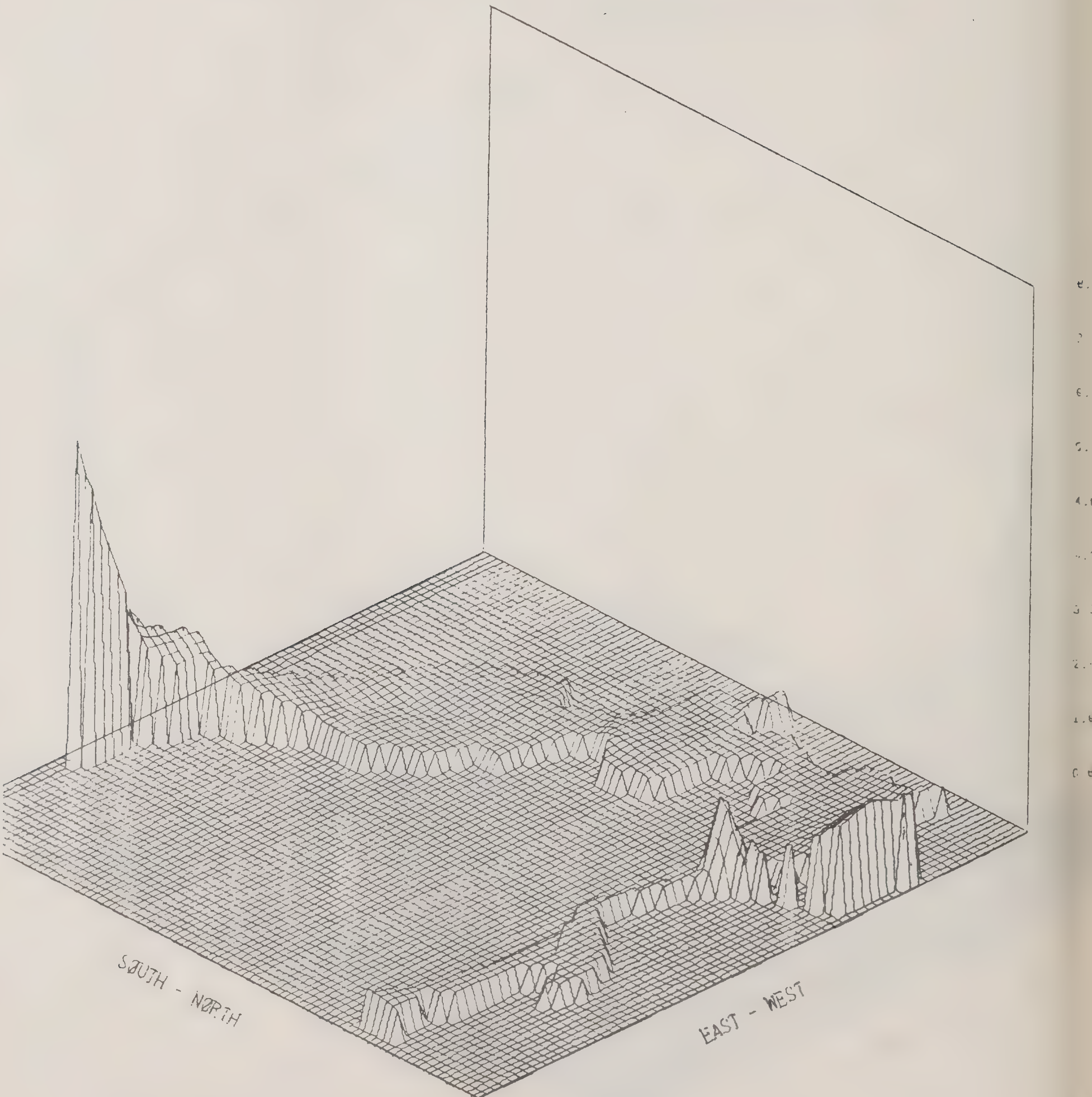

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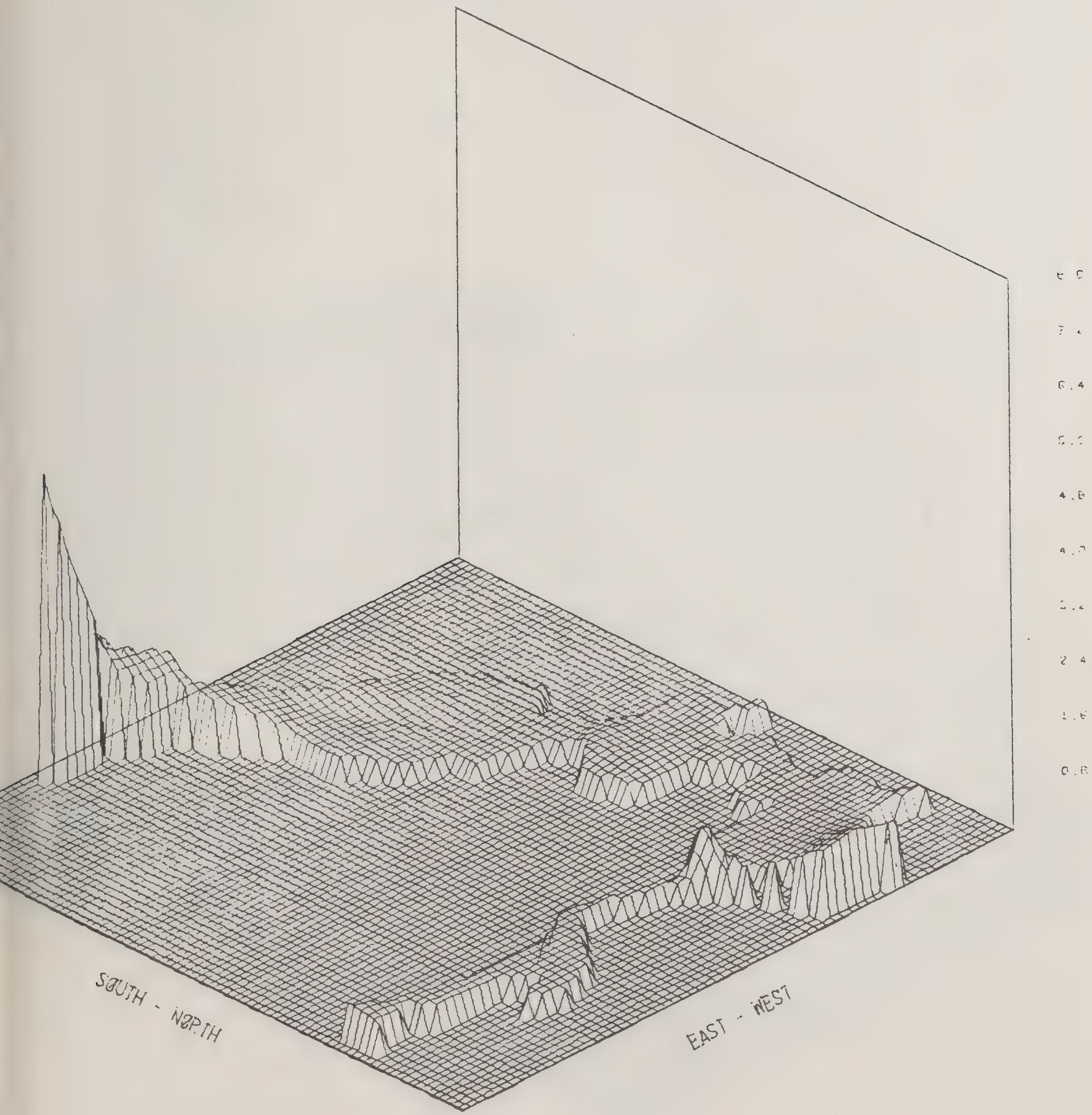
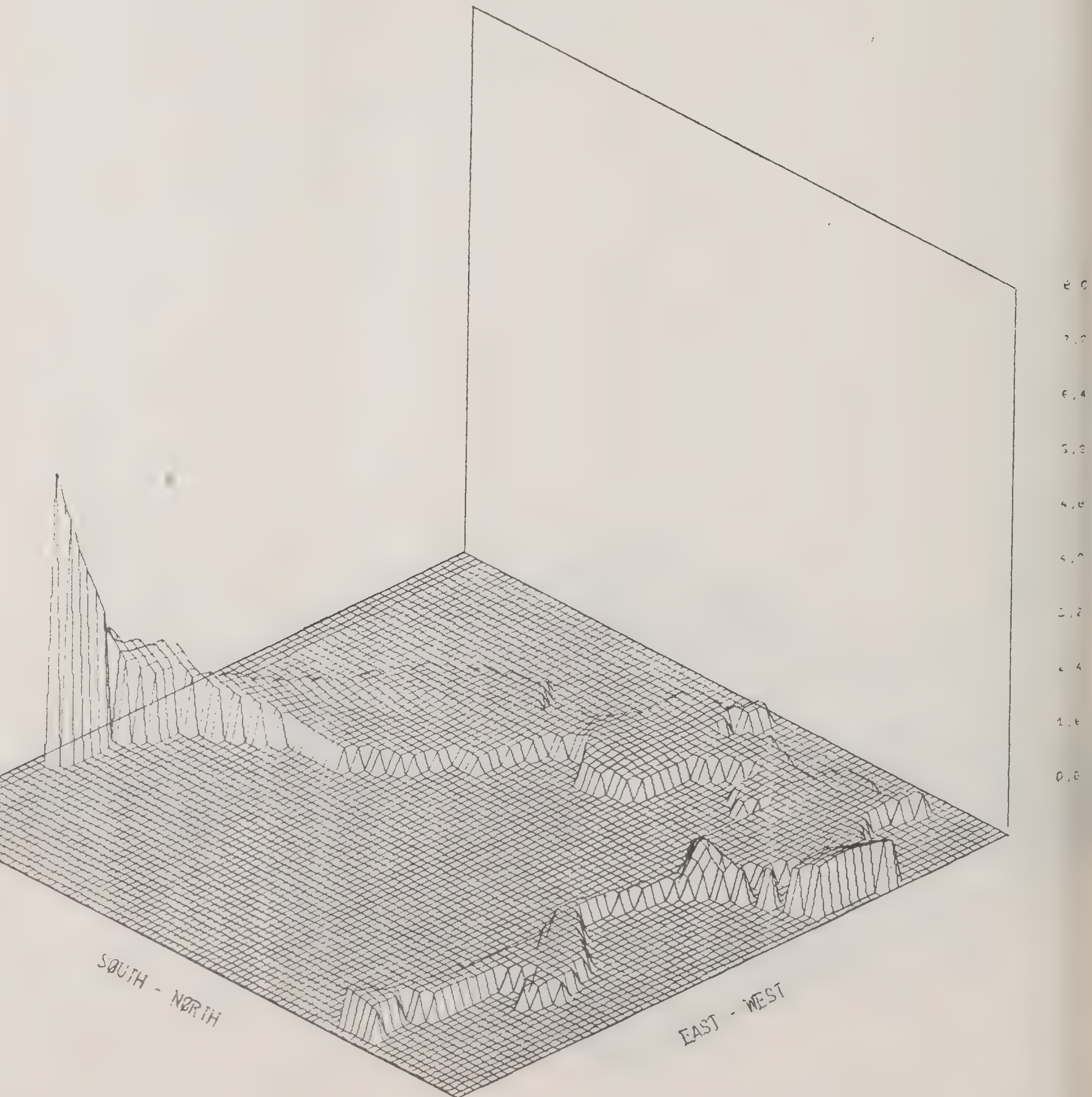


BØDS,.375,DAY 4 AFTER STORM



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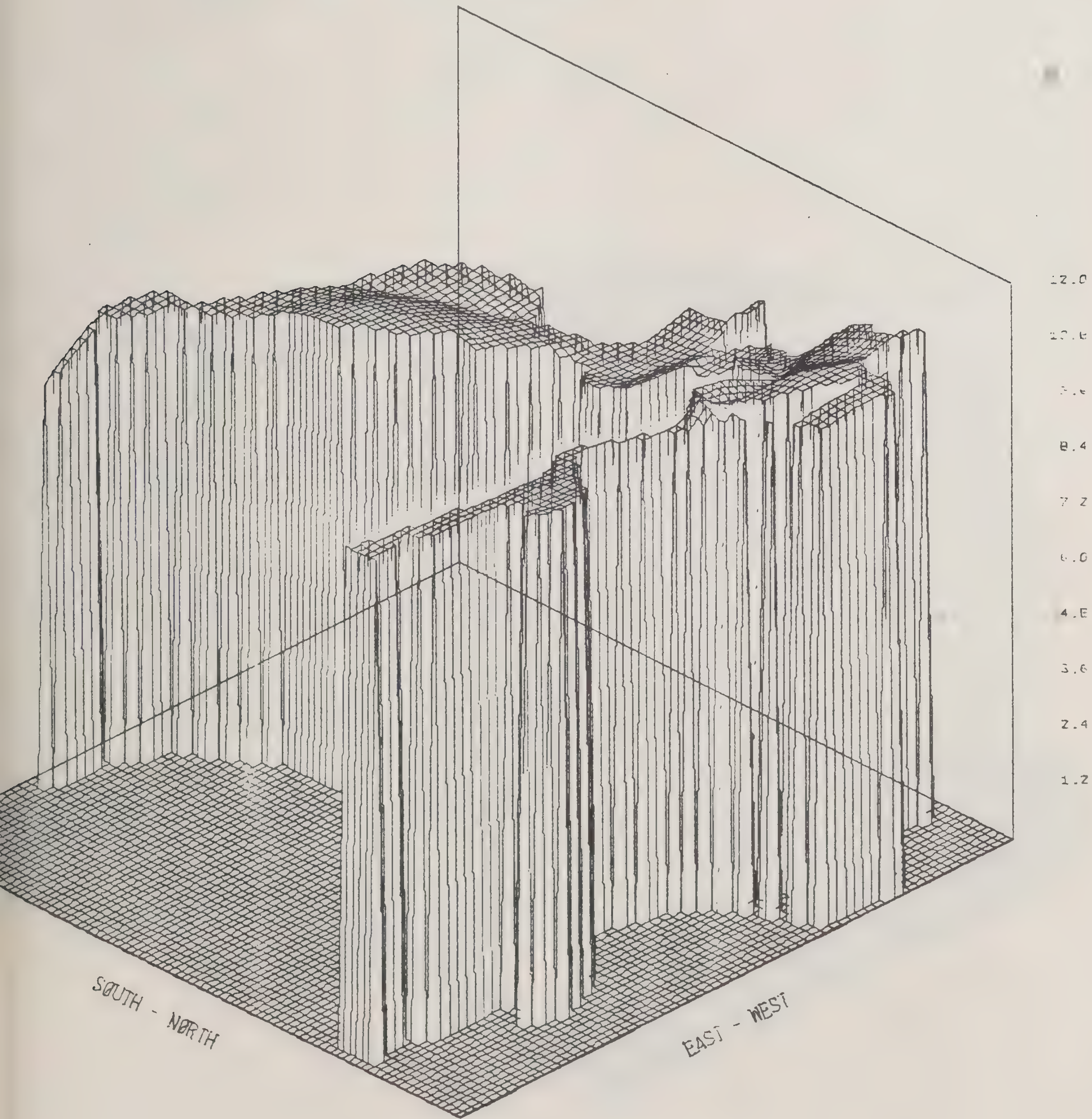

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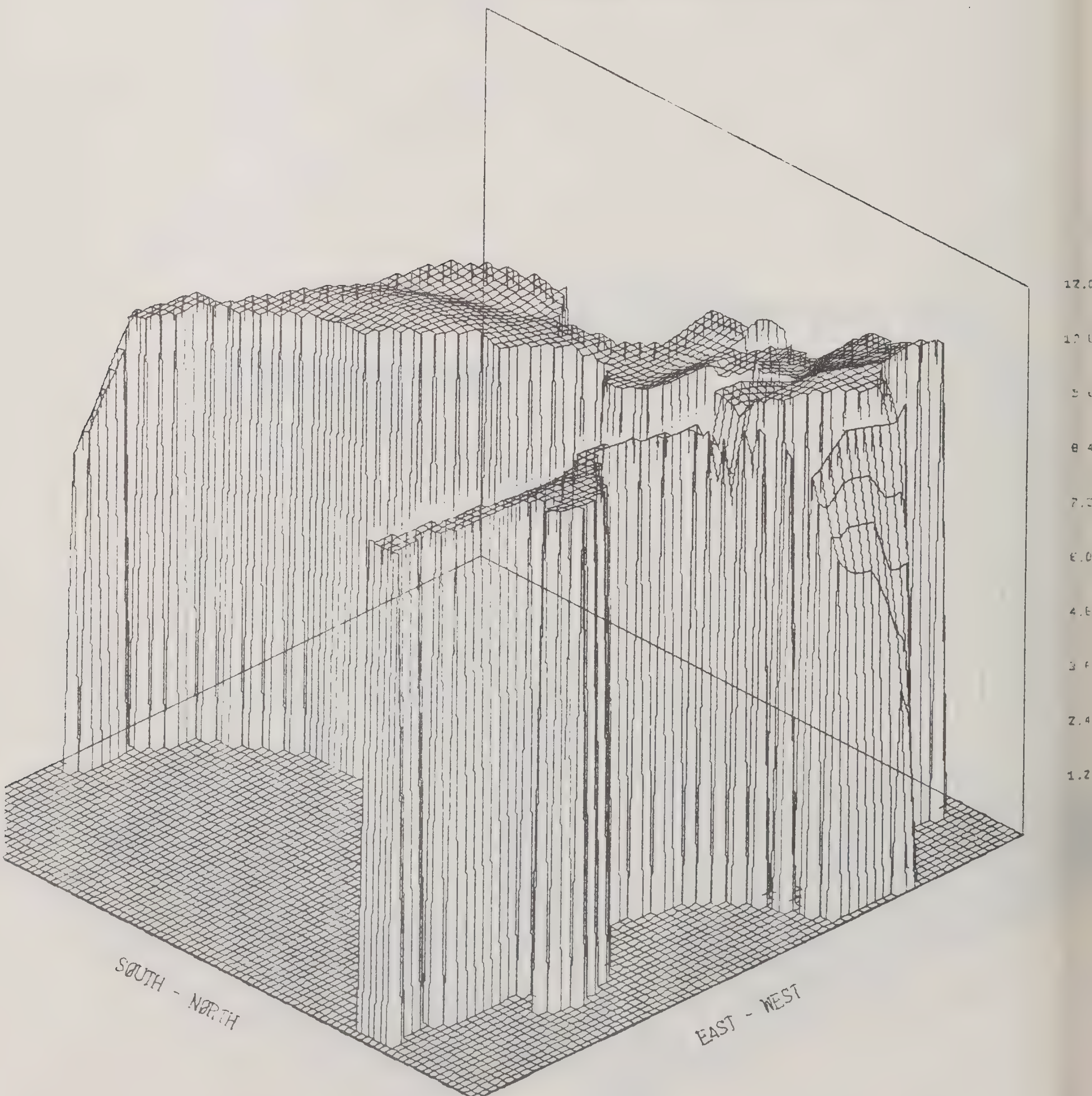

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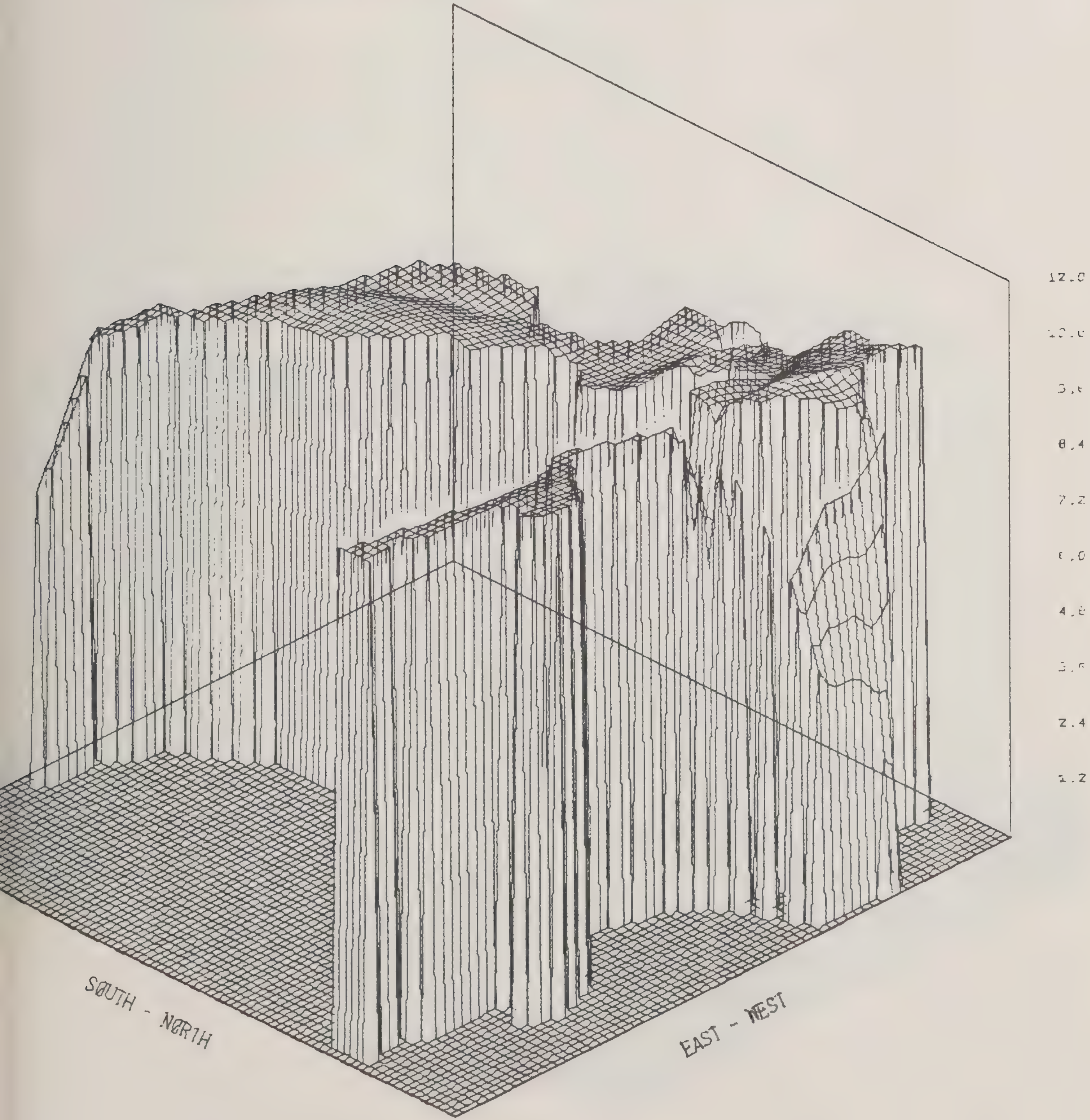

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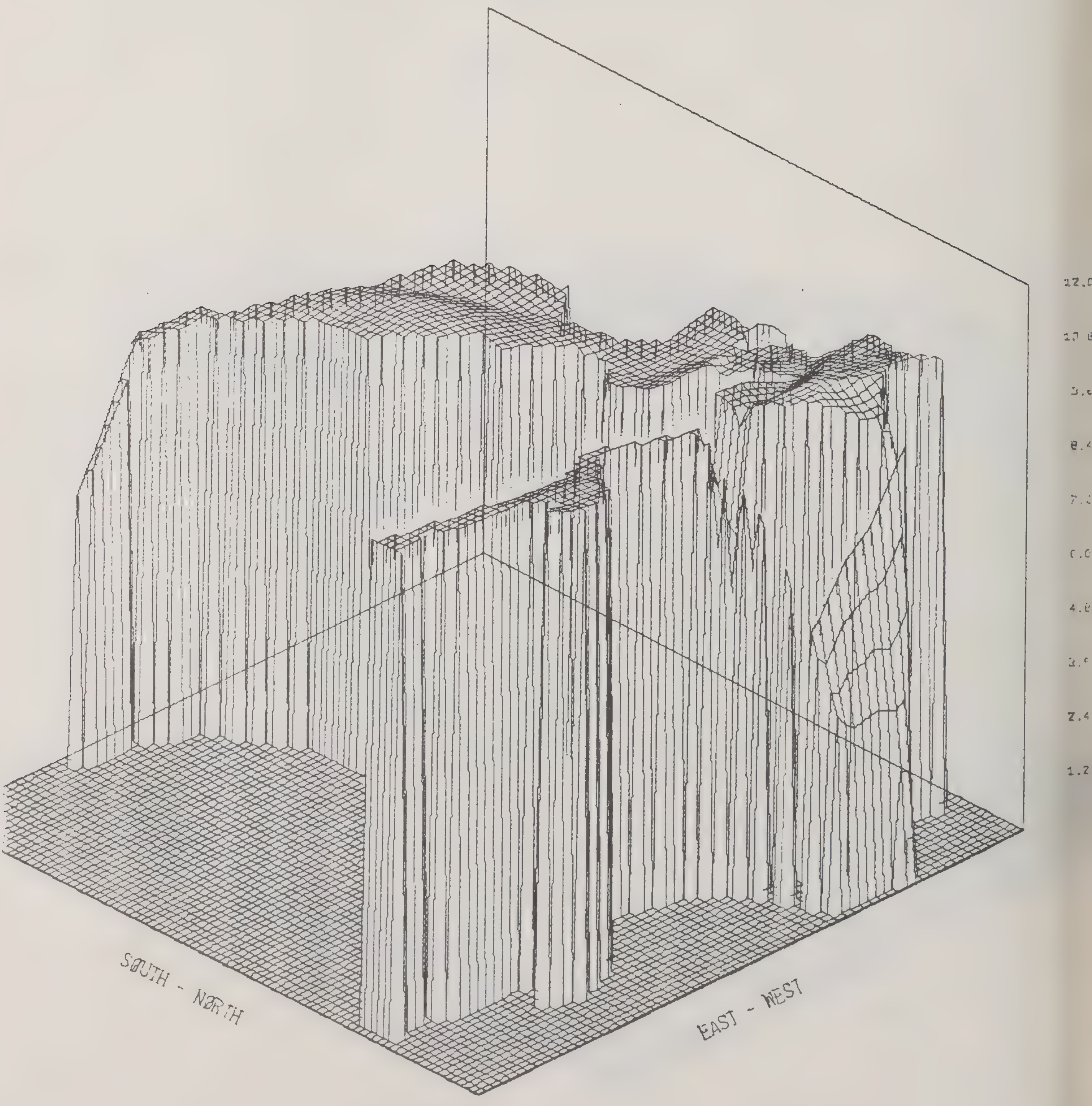

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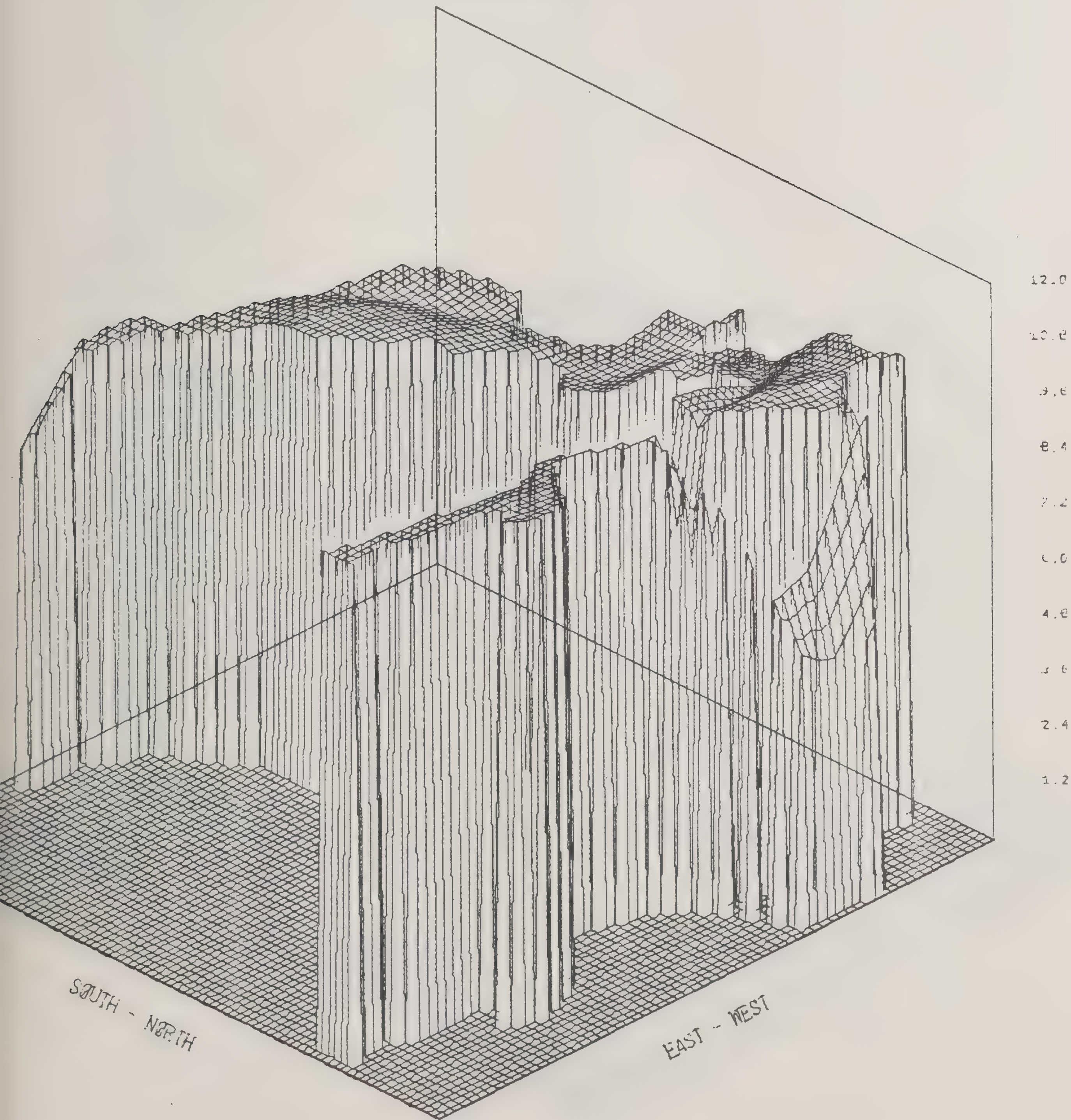

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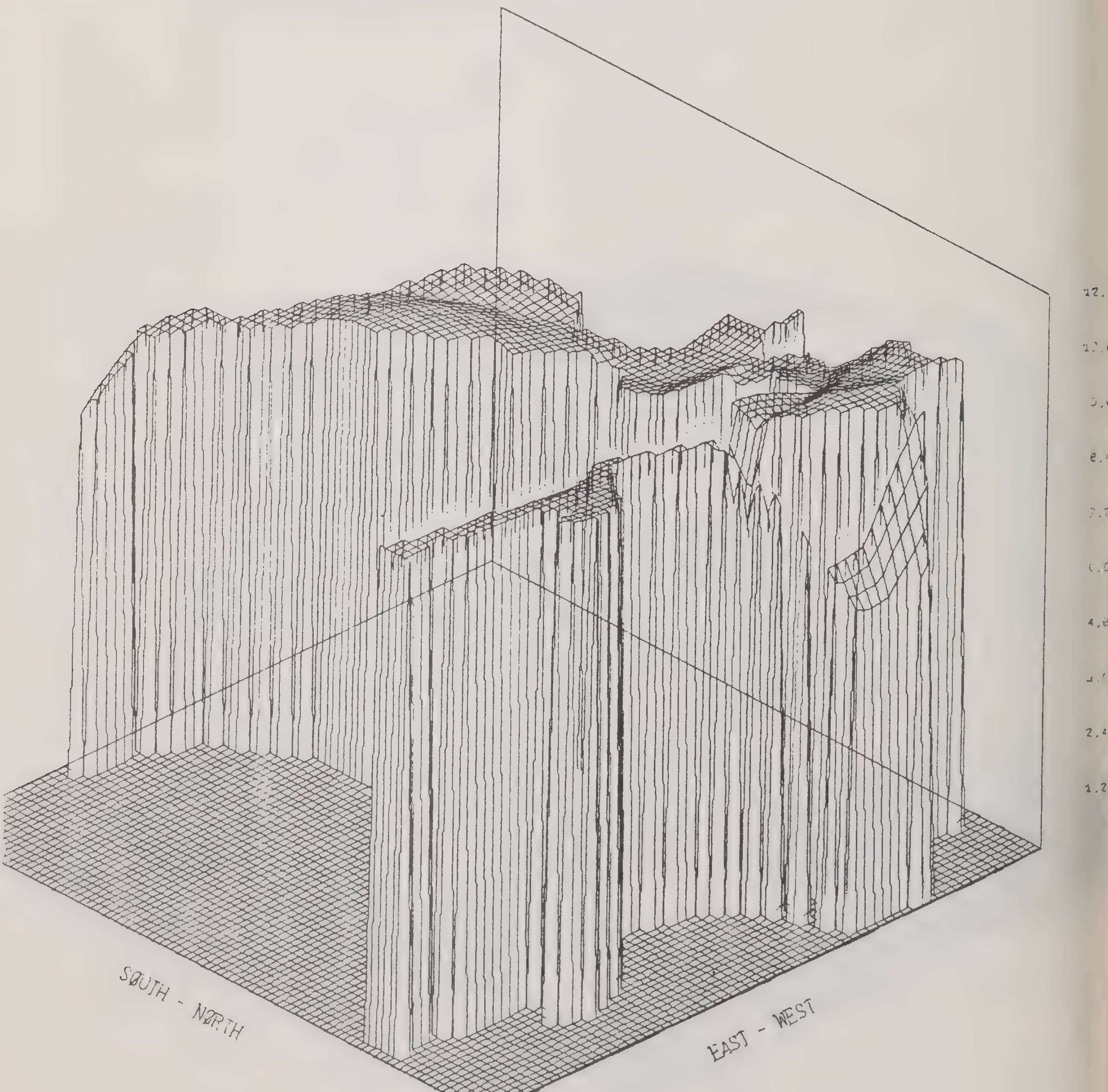

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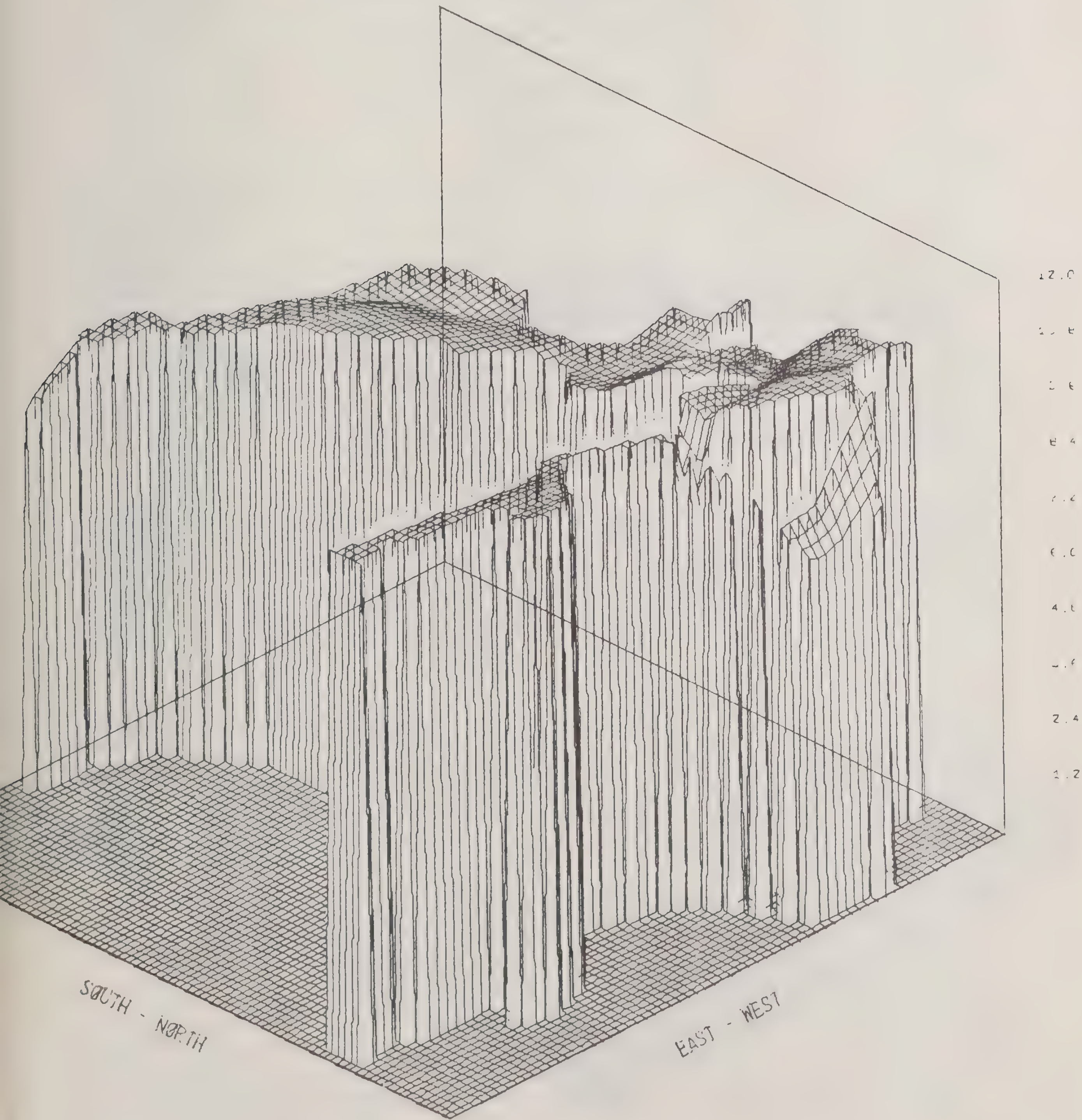

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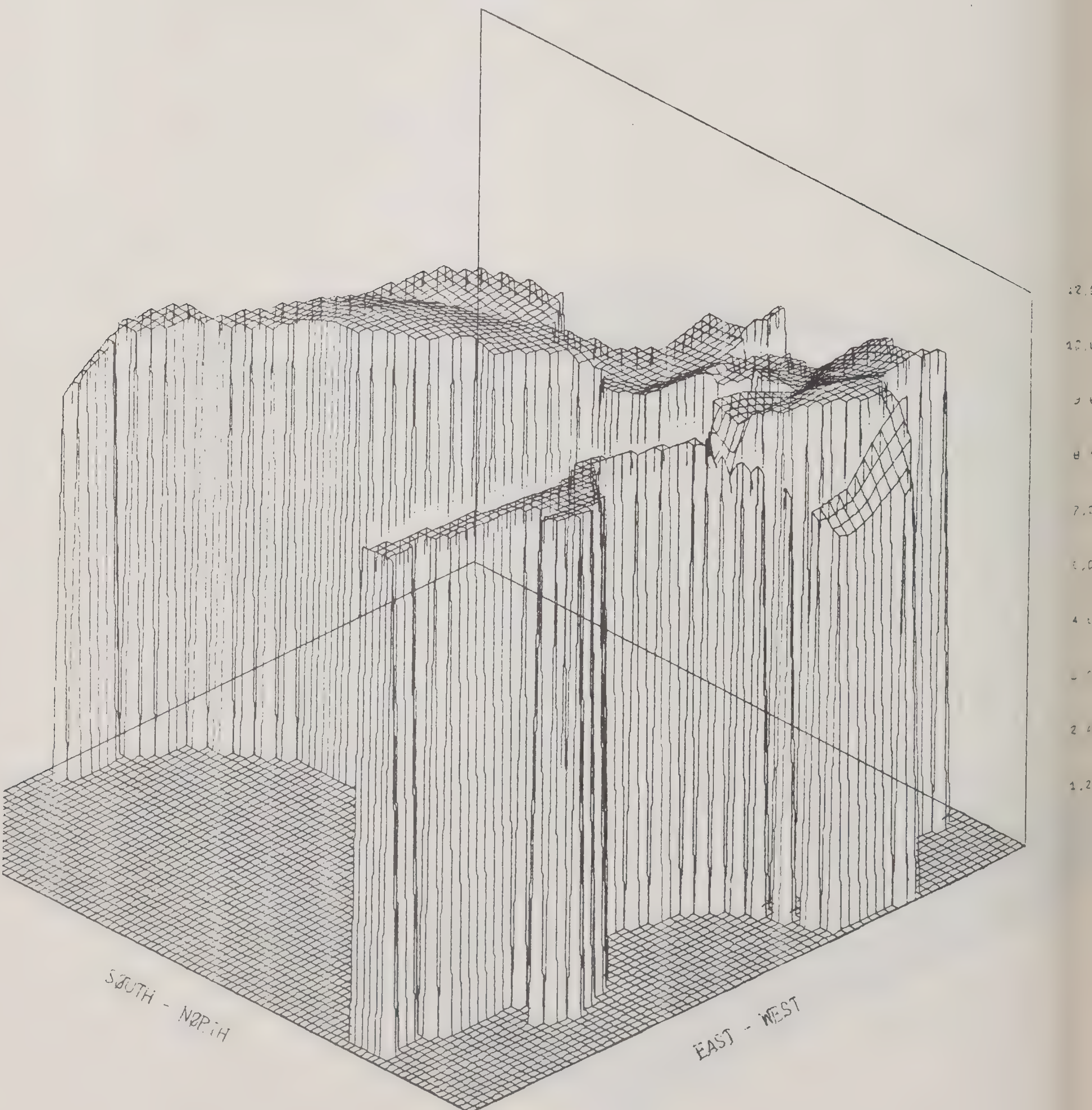

WQ/Tech Memo 24/August, 1977

T. Bursztynsky

Water Quality Management Plans

Dredging and Spoil Disposal

Technical Memorandum No. 24

August 1977

INTRODUCTION

Dredging of San Francisco Bay sediments is an activity essential to the economic well-being of the entire region and increases recreational opportunity on the Bay. Dredging maintains the open channels needed by waterborne commerce for access to our ports and by U.S. Navy vessels for access to military bases. Private pleasure craft often use dredged channels to enter anchorages at local marinas. Yet this vital activity of dredging, and the accompanying spoil disposal, accent the boundary between a natural environment and man's need to change that environment in order to promote his economic well-being.

Dredging physically moves massive amounts of bottom sediment and benthic organisms, often destroying the organisms. Bottom muds are resuspended in clouds, degrading local water quality and affecting pelagic marine life. Spoil disposal in water further resuspends fine particles and covers the disposal area bottom. Spoil disposal on land can destroy terrestrial vegetation, affect water quality, and be unsuitable for construction or revegetation.

The real and imagined consequences of dredging-related activities have given rise to public concern and debate over dredging projects. Questions are raised as to the degree of environmental insult caused by dredging and its permanence. Answers developed by the scientific community and the principal dredging agency, the U. S. Army Corps of Engineers, never seem to fully resolve the issues.

Because of obvious apparent impact of dredging activities on water quality and the public controversy associated with these activities, a special study on dredging was commissioned as part of the Environmental Management Plan preparation. The study, conducted by Dr. Louis H. Di Salvo, reviewed the bulk of scientific literature concerning the effects of dredging, particularly in San Francisco Bay. This study included the reports of recent research activities, the results of which were too new to have been reviewed by the general scientific community. It was the intent of this study to sort the thousands of pages of scientific reports and provide an initial filtering action that would produce conclusions of environmental effects, problem areas, and recommendations.

A special study report was prepared and is the basis of this technical memorandum. The report clearly develops the major issues of dredging in the San Francisco Bay area and analyzes the currently available scientific information on those issues. The conclusions developed by the special study report are accepted as the working conclusions of this memorandum as are the statements on current problem areas. The recommendations have been modified and combined into a series of possible actions for analysis under the 208 program. The following section presents and develops these actions.

POSSIBLE ACTIONS

The recommendations of the special study report are directed at the basic sources of controversy surrounding dredging, namely the toxic materials which accumulate in Bay sediment. Specifically the special study report calls for a reduction of toxic materials entering the Bay and reductions in sediments from surface runoff in the Bay area. Also, recognizing the tremendous lack of information on the San Francisco Bay ecosystem, a skeletal outline of a monitoring and research program was presented. The basic essence of the special study recommendations may be stated as recommended policies of the Miscellaneous Sources of Water Pollution Management Plan with appropriate action items.

The recommended policies accept the basic economic and military needs for the dredging of shipping channels. They also accept as a conclusion of the special study report the absence of gross and obvious environmental insult outside the immediate vicinity of dredging and spoil disposal activities. The following policies are recommended for the Dredging and Spoil Disposal Management Plan:

- Reduce toxic waste contamination of sediments
- Reduce sediment accumulation in San Francisco Bay
- Obtain basic San Francisco Bay specific data needed to adequately evaluate dredging programs.

Only one specific action is proposed for this management plan:

1. Develop San Francisco Bay monitoring program for water quality, biota, and specific effects of dredging and spoil disposal.

Reduce Toxic Waste Contamination of Sediments

The historic concerns over dredging were over release of suspended particulates and oxygen depletion of water. The special study has shown that in the high flow regime characteristic of San Francisco Bay, oxygen depletion occurs in the immediate vicinity of dredging operations but is very rapidly negated through dilution with incoming waters. The natural turbidity of Bay waters is high and aquatic organisms native to the Bay appear to have a high tolerance to sediment suspended as a result of dredging operations.

A newer concern over dredging activities relates to the resuspension and release of toxic metals and chemicals that have precipitated with Bay sediments. The effects of these upon microplankton, filter feeders or other marine life is poorly understood and suspected by many to be negative. The policy of reducing toxic waste contamination of sediments is aimed directly at this concern but would not be implemented in this management plan. Rather, the policy would be implemented by the adoption of plan elements dealing with toxic wastes in the other water quality, surface runoff, and solid waste management plans.

Reduce Sediment Accumulation In San Francisco Bay

A reduction in the frequency of maintenance dredging would concomitantly lessen the incidence of pollutant discharge from dredging activities. Although a great deal of sediment enters the Bay by the Sacramento and San Joaquin rivers, storm water runoff from the Bay area drainage basin is also a significant factor. A reduction in local sediment discharge to the Bay should result in a reduced need for maintenance dredging. Specific action items to accomplish this reduction would be implemented as part of the Surface Runoff Management Plan.

Obtain San Francisco Bay Data

The special study report indicated that the understanding of subtle, long-term, environmental impacts of dredging activities upon estuarine ecosystems is in the infancy of development. The problem is further complicated by the unique hydraulic flow regime of San Francisco Bay which makes extrapolation of information from other estuaries a poor practice. Because of these factors, the scientific data collected to date cannot with assurance provide answers to the many questions about dredging effects.

The intent of this policy is to obtain the data we need in order to make informed judgments on dredging practices. The specific action would be to develop a San Francisco Bay monitoring program that would establish baseline conditions of water quality and biota in the Bay. This aspect of the program could be accomplished with a minimal effort if it were coordinated with ongoing monitoring programs and the monitoring programs suggested for the other water quality management plans.

The monitoring program would also collect specific data on conditions before, during and after dredging and spoil disposal operations. It is intended that such data could be used to evaluate the subtle and long-term effects of dredging and provide a basis for changes in current dredging programs.

The comprehensive monitoring program should be developed and implemented by a regionally based agency whose primary concern is in the protection of Bay water quality. This would appear to be the RWQCB although the frequent assistance of the Department of Fish and Game may become essential. While other agencies have conducted studies of dredging in San Francisco Bay, notably on the Federal level, and produced credible reports, it could be argued that basic data upon which regulations are drawn should be produced by an organization with no potentially conflicting interests.

Water Quality Management Plan

Estimated Costs of Treating Industrial Discharges

Technical Memorandum No. 26

October 4, 1977

The cost of building and operating treatment facilities required for industrial dischargers to meet applicable discharge requirements constitutes a direct economic impact of the Water Quality Management Plan. For industries discharging directly to receiving waters, 1977 compliance deadlines (best practicable treatment, or BPT) have been met; it is estimated that the cost of meeting 1983 deadlines (best available treatment, or BAT) will amount to the equivalent of $25 million per year in the Bay Area (1977 dollars). The cost of pretreatment required for industries discharging to municipal sewer systems is not capable of being estimated, for several reasons.

Bay Area industries discharging to municipal systems will be charged an estimated $20 million per year by those operating agencies for the industrial share of capital costs, operation and maintenance, and interest. These charges will offset a portion of the estimated $230 million per year equivalent annual cost shown for municipal facilities in the Water Quality Management Plan.

The following sections discuss these points in greater detail.

Treatment for Direct Discharges

The Regional Impacts Study[1] by A.D. Little, Inc. presented cost estimates for industrial compliance with BPT and BAT requirements for the Suisun Bay/Lower Delta portion of the Bay Area. Because significant direct industrial dischargers are highly concentrated in that vicinity, it was possible to extrapolate from that study to obtain an estimate for the entire Bay Area.

Industrial segments involved and methodology used were as follows:

- Petroleum refineries: Four of six Bay Area refineries are in the A. D. Little study area. Cost estimates were extrapolated to cover all six on the basis of refinery capacity. Effects of refinery size and complexity were accounted for through information given in EPA's Development Document for the Petroleum Refining Industry.[2]

Annualized cost of meeting BAT for the refinery segment was estimated at $13 million per year (1977 dollars).

- o Chemicals: Most significant directly discharging chemical manufacturers are included in the A.D. Little area. Extrapolation to include all significant plants was done on the basis of process flow volumes. Estimated equivalent annual cost for this segment is $7 million.

- o Paper: The only two paper mills in the Bay Area are in the lower delta; no extrapolation was necessary. Equivalent annual cost was estimated at $2.2 million.

- o Primary Metals: The only significant directly discharging primary metals plant in the Bay Area is in the lower delta. Estimated equivalent annual cost is $1.4 million.

- o Food: There are two significant direct-discharging food processors in the Bay Area, both within the A.D. Little study area. Estimated equivalent annual cost is $1 million.

The following assumptions were made in using the figures from the Regional Impacts Study:

- o Estimates in that study were given in 1972 dollars. Capital costs were updated to 1977 using the Engineering News-Record Construction Cost Index for the Bay Area. Operation and maintenance costs were updated using the Consumer Price Index for the Bay Area.

- o Construction costs were annualized using a 10% interest rate and 20 year project life.

Pretreatment of Non-Direct Discharges

Regulation of industrial discharges to municipal systems is in a state of substantial flux. Although the Water Pollution Control Act of 1972 requires that EPA prescribe regulations for indirect discharges, there are still few standards in place for industrial segments which discharge troublesome pollutants. State regulations require that municipal systems receiving industrial wastes regulate those discharges, but do not specify any required levels of control. Discharge limits imposed by municipal systems on their tributary industries depend largely on the discharge limits the municipal systems themselves must meet. The level of control placed on industrial discuargers thus can vary significantly from one municipality to another.

In February, 1977, EPA issued a proposed regulation containing four possible alternative approaches to regulation of non-direct industrial discharges. Technical requirements were not spelled out but a substantial range of stringency among the alternatives was indicated. Some of the alternatives would permit relaxation

of discharge standards on a local option basis provided receiving water quality was maintained. Implementation ranged from substantial Federal involvement with industrial dischargers to regulation by local sewerage agency. After hearings and receipt of written comments last Spring, EPA is continuing the study of regulatory alternatives (the comment period produced additional viable alternatives). Given these and other uncertainties, the pace of implementation has been somewhat uneven among the municipalities having industrial dischargers.

Thus local source control programs for industrial discharges are, in general, underway, but are proceeding at various rates toward various interim goals. When EPA's regulations are announced, national schedules and standards will be in effect, but local variation may still be possible. Against this background, it is quite difficult to describe the present status of pretreatment in the Bay Area or to define what final level of pretreatment will be required.

The situation with regard to cost information is also bleak. The Regional Impacts[1] Study previously cited did not address the question of costs for pretreatment. On the national level, several studies[3,4] exist which offer hope of obtaining some kind of cost benchmark. However, the studies available are in such substantial disagreement as to costs that it is difficult to make use of any of them with any confidence at all. We have reluctantly concluded that the cost of achieving required pretreatment levels cannot be estimated at this time.

Treatment in Municipal Plants for Non-Direct Discharges

State regulations on revenue programs[5] indicate how industry is to share in costs of local sewerage systems. The industrial share of capital costs is to be recovered over a thirty year period; industry is to pay a pro-rata share of annual operation, maintenance and bond interest costs. Sharing is based on a formula including flow volumes and discharge rates for certain pollutants.

For present purposes we have assumed that industry will share costs based entirely on flow volumes. In the Bay Area, industry contributes approximately 12% of total flow volume, thus would pay about 12% of operation and maintenance costs. Because bonds are used to finance only the local share of capital costs, the grant-funded share (typically 87½%) is recovered without interest. The annual payment on this basis is about half that where full interest is assumed (as in the calculation of equivalent annual value of municipal treatment capital costs). Thus the industrial share of the annualized capital cost of municipal treatment will be about 6%.

The estimated annualized cost of the twenty-year project list, which is a part of the Water Quality Management Plan, is $230 million per year (1977 dollars). Based on the preceding paragraph, it is

anticipated that Bay Area industry (non-direct dischargers) will pay around $20 million a year in user charges to municipal sewerage agencies.

REFERENCES

1 Little, Arthur D., Inc., Water Pollution Control Act of 1972 - Regional Impacts - San Francisco Bay/Central Valley. (Washington: National Commission on Water Quality, 1975), Vol. II, p. II-4.

2 U.S. Environmental Protection Agency, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Petroleum Refining Point Source Category (Washington: 1974), pp. 117-131.

3 Staff Report to the National Commission on Water Quality (Washington: 1976).

4 U.S. Environmental Protection Agency, The Economics of Clean Water - 1973 (Washington: 1973)

5 California State Water Resources Control Board, Revenue Program Guidelines for Wastewater Agencies (Sacramento: 1974), pp. 6-7, 10.

T. Bursztynsky

WATER QUALITY MANAGEMENT PLANS

EFFECTS OF WATER CONSERVATION UPON WASTEWATER TREATMENT

Technical Memorandum No. 27

November, 1977
revised February, 1978

INTRODUCTION

This technical memorandum is the basis for integration of the Draft Water Quality Management Plan and the Draft Water Supply Management Plan, both released in October 1977. Specifically, this document presents the effects the Draft Water Supply Management Plan would have upon wastewater treatment facilities. Effects to be explored include wastewater flow, strength, size of treatment facilities and need for expansion. These estimated effects would occur only if the Draft Water Supply Management Plan is adopted. If the Draft Water Supply Management Plan is amended prior to adoption, then the effects could change.

The Draft Water Quality Management Plan included a 20-year project list of municipal wastewater facilities. This project list was obtained by contacting each municipal wastewater management agency and using their estimates of future needed facilities. This is only an interim list and may be changed during the development of the Environmental Management Plan.

Estimated municipal and non-discrete industrial wastewater loads were presented in Technical Memorandum No. 15. These wastewater loads, or discharges, were based upon the per capita waste generation rates obtained from the wastewater management agencies and different sets of population projections developed by ABAG. The wastewater loads are now being revised to conform with the newest sets of population projections. Potential discrepancies between an agency's estimate of future needs as expressed in the draft 20-year project list and wastewater loads projected by ABAG have not been resolved in this document.

The Draft Water Supply Plan, if implemented, would produce reductions in water use and wastewater discharged to sewers. These reductions can alter the per capita wastewater generation rates and thereby, the wastewater loads projected by ABAG.

REVISED PER CAPITA WASTEWATER GENERATION

Water conservation features of the Draft Water Supply Management Plan to a large part are based upon the moderate implementation plan outlined in "Water Conservation, Reuse, and Supply Study for the San Francisco Bay Region," prepared for ABAG by J. B. Gilbert and Associates. Water conservation actions affect both existing and new housing. Existing homes would be modified through the addition of an inexpensive flow reduction device in showers and volume displacing bottles in toilet tanks. New homes would have flow reduction devices built into the plumbing system, including shower flow limiters, low volume flush toilets, faucet flow controls with aerators, shower cut-off valves, thermostatic mixing valves, and pressure regulators.

Estimated reductions in inside water use translate directly to wastewater flow reductions. The water conservation actions would save an estimated 1.7 gallons per capital day (gpcd) averaged over all existing residences although implementation is expected in only 15 to 30 percent of existing residences. With 100 percent implementation in new housing, the water conservation actions would save 16.6 gpcd for all residents of new housing. It is also expected that media campaigns directed at awakening public awareness of water supply limits could produce an additional five percent inside water use reduction on old and new housing.

As an example:

A typical wastewater generation rate is 100 gpcd. In existing housing this would be reduced to 98.3 gpcd plus an additional five percent for a new rate of 93.4 gpcd. In new housing, 100 gpcd would be reduced to 83.4 gpcd plus an additional five percent for a new rate of 79.2 gpcd.

The conservation measures in the Draft Water Supply Plan are predicted to reduce domestic wastewater flows and are also predicted to reduce industrial, commercial, and public flows by five percent. However, the pollutants carried in those flows would not be reduced. Rather, the concentration of the pollutants in reduced flows would be expected to increase. The resulting total mass of pollutants would be the same with or without water conservation measures.

REDUCED WASTEWATER GENERATION BY SEWERAGE UNIT

Appendix A presents wastewater flows for individual sewerage units, including infiltration flows. The flows shown in Appendix A were calculated for the three growth models: Base Case 1, Base Case 2, and Compact Growth. The flows were also calculated with the assumption that water conservation measures would be implemented.

Table 1 summarizes the effects of water conservation on wastewater flows for each sewerage unit in the year 2000. The projected waste flow reductions vary from 50 to 20 percent. The larger percentage reductions due to water conservation occur in the high growth model, Base Case 1, because of its larger proportion of new housing. We had previously shown that water savings for new housing may be substantially greater than for existing housing.

With a few exceptions, 6 percent flow reductions are calculated to occur in areas with minimum projected growth. Most sewerage units are estimated to achieve approximately 10 percent flow reductions and some high growth areas can realized up to 20 percent reductions in the year 2000.

It was estimated that the water conservation plan would take effect in the year 1980. That is, all households in existence in 1980 would achieve the minimum average reductions of approximately 6 percent. Households formed after 1980 would achieve flow reductions of 20 to 21 percent.

EFFECTS OF CONSERVATION UPON WASTEWATER TREATMENT FACILITIES

Water conservation resulting in reduced wastewater flows can have an effect upon wastewater treatment facilities. The individual treatment steps, referred to as unit processes, will be affected differently. Specific unit processes this memorandum addresses include sewerage transport, headworks, primary and secondary sedimentation, biological treatment, chemical treatment, filtration, disinfection, and sewage sludge solids handling.

EXISTING VS. NEW FACILITIES

A distinction must be made between existing wastewater facilities and those yet to be constructed. Existing facilities have generally been designed for a particular flow. The effects of reduced flow must be accommodated within the normal operation of a facility. Fortunately, wastewater facilities are constructed and expanded in substantial size increments. Actual flows reaching a plant increase gradually and are usually less than the design capacity. Therefore, facilities are designed to operate satisfactorily over a range of flows and pollutant loadings, although changes in operation may be needed. A consideration that should be explored is whether an existing facility could serve an additional population increment beyond its design capacity if water conservation were practiced.

Issues relating to new, yet to be constructed treatment plants center upon the sizing of unit processes. Reduced hydraulic flows may permit size reductions in some processes designed upon the basis of wastewater flow and thus might produce savings in construction costs.

TABLE 1: WASTEWATER FLOW REDUCTIONS DUE TO WATER CONSERVATION

Wastewater flow reductions in year 2000, percent

	Sewerage Unit	Base Case 1	Base Case 2	Compact Growth
1.	Richardson Bay	11	10	9
2.	Sausalito	11	9	9
3.	Tiburon	8	9	6
4.	Mill Valley	8	9	7
5.	Ross Valley	9	9	7
6.	San Rafael-San Quentin	7	6	7
7.	Las Gallinas-Marin Bay	11	10	8
8.	Novato-Hamilton	14	14	11
9.	Petaluma	13	13	13
10.	Sonoma Valley	13	13	14
11.	Napa-American Canyon	10	9	9
12.	Vallejo-Mare Island	9	9	9
13.	Benicia	14	12	12
14.	Fairfield-Suisun-Travis	9	8	8
15.	East County*	18	20	14
16.	Antioch	11	11	9
17.	CCCSD 7A & 7B	10	9	8
18.	Central CCCSD-Mt. View	9	8	8
19.	Crockett-Port Costa	7	8	8
20.	Rodeo	13	13	11
21.	Pinole-Hercules	13	11	11
22.	San Pablo	8	7	7
23.	Richmond	7	6	6
24.	EBMUD	8	6	7
25.	San Leandro	8	8	6
26.	Oro Loma-Castro Valley	7	7	7
27.	Hayward	7	7	7
28.	29, 30 Union-Newark-Fremont	8	7	7
31.	Livermore	10	10	9
32.	VCSD-Pleasanton	10	9	9
33.	San Jose-Santa Clara	7	6	7
34.	Sunnyvale	6	6	6
35.	Palo Alto	7	6	7
36.	Menlo Park	8	7	7
37.	Redwood City	7	6	6
38.	San Carlos-Belmont	7	7	6
39.	Estero	8	6	6
40.	San Mateo	12	8	8
41.	Burlingame	15	10	7
42.	Millbrae	8	6	7
43.	SSF-Airport-San Bruno	6	5	5
44.	Guadalupe Valley**	-	-	-
45.	Montara-Granada-Half Moon Bay	13	13	12
46.	Pacifica	12	9	10
47.	N. San Mateo	8	7	10
48.	Southeast	6	6	6
49.	North Point	6	5	5
50.	Richmond-Sunset	6	6	6
	Regional Total	8	7	7

WASTEWATER FLOWS AND PLANT LOADING

Generally, the design of a domestic sewer is based upon the flow of water the sewer must carry. Substantial reductions in wastewater flow can result in a smaller size sewer needed to carry that flow.

Municipal wastewater treatment plants are designed on the basis of a number of factors. These factors include water flow, organic loading, solids loading, and special wastewater constituents such as grease, oil, ammonia, metals or nutrients. Thus, identification of a treatment plant's capacity strictly on the basis of size in million gallons per day (mgd) can be misleading. All loading factors must be taken into account when evaluating potential size reductions in a treatment plant.

Wastewater flows are composed of four basic constituents: domestic discharges, infiltration, inflow, and industrial/commercial discharges. Except in San Francisco, storm and sanitary sewers are separate in the Bay Area. Infiltration flows are usually small in most communities of the Bay Area and often included in the 100 gpcd typical wastewater generation rate.

During any 24-hour period there are substantial variations in sewage flow. High flows occur in morning and evening hours and low flows during afternoons and night hours. Depending upon the number of households in a service area, peak 24-hour flows may be 150 to 600 percent of the average. Water conservation measures that reduce average daily flows by a certain percentage should reduce the peak dry weather flows by approximately the same percentage.

Although the majority of sewers in the Bay Area are not intended to carry storm flows, they often must do just that. For a variety of reasons, including broken pipes, poor pipe joints, open manhole covers, and illegal connections, rain water runoff can substantially increase peak flows during storm events. Technical Memorandum No 5, "Existing and Planned Wastewater Management Facilities in the San Francisco Bay Region" presented average dry weather flows, peak dry weather flows and peak wet weather flows for which existing facilities had been designed or which they currently experience. Typical values of wet weather peaking factors range from 2 to 8 times the average dry weather flow. This is an extremely large range of flows which must be accommodated at the wastewater treatment plant. There was insufficient information to establish the duration and frequency of the peak wet weather flows.

Raw wastewater constituent loading factors are estimated to be the same with or without water conservation. This is based upon the premise that water serves only as a transporting medium and the need to remove a certain amount of wastes does not change with conservation. Therefore, wastewater constituent loadings upon a treatment plant are not expected to change.

SEWERS

Sewers are designed to carry maximum flows without backing up and to prevent deposition of solids due to slow water velocities at typical daily flows. Reductions in the maximum flows of 6 to 20 percent in existing sewers will not harm flow characteristics and should result in extra capacity for more sewer connections. For an existing sewer designed to flow at 2 feet/sec when half full, a reduction in flow of 20 percent should drop water velocity to 1.85 feet/sec. This drop is insufficient to cause solids deposition. Thus, reduced flows should not adversely affect existing sewers. Flows reduced by 30 to 50 percent as a result of the current drought have caused solids deposition and foul odors in some areas. However, these flow reductions are greater than expected from water conservation.

In the design of new sewers to serve new neighborhoods, maximum flow reductions of 20 percent may be expected. This flow reduction may affect the size of sewer selected and could lower construction costs. However, the need to provide sewer capacity for expected infiltration and storm water inflow could make actual size reductions small. This factor may change as new sewer construction techniques are developed and implemented to improved pipe joints, seal manholes and otherwise reduce inflow.

HEADWORKS

The headworks of a sewage treatment plant consist of receiving wells, lift pumps, screens, and grit removal chambers and possible chemical dosing facilities. Headworks are designed to accommodate a very wide range of flows, from minimum daily to peak wet weather, and to continue functioning efficiently.

Grit removal chambers are the most sensitive units to effects of flow changes upon operating efficiency. If liquid velocities drop too low, then excess organic matter will be deposited with the grit. Aerated grit chambers are designed on a peak flow basis and would not be adversely affected by flow reductions reaching 20 percent. Velocity controlled grit chambers are very sensitive to wastewater flow. These grit chambers use proportioned weirs, Parshall flumes or other fixed control sections to maintain a nearly constant velocity as liquid flow (and depth of liquid in the chamber) varies. If due to conservation, minimum design flow falls below the proportioning range of these grit chambers, then excess organic deposition will occur.

With the occasional exception of velocity controlled grit chambers, reductions of flows to existing headworks should be readily accommodated and in all cases, could result in an additional increment of available capacity. The design of new headworks could include size reductions for some cost savings; however, capacity must always be provided for the peak wet weather flows.

PRIMARY AND SECONDARY SEDIMENTATION

Sedimentation basins slow the flow of wastewater so that suspended particles may drop to the bottom or, float to the top. Primary sedimentation basins remove floatable grease and oil and settleable raw sewage solids. Secondary sedimentation basins separate active biological mass from the waste stream, and in the case of activated sludge, return a portion of it to the biological treatment tank. Sedimentation basins are designed on the basis of flow, expressed as overflow rate. Typical hydraulic loading for primary clarifiers would range from 800 to 1,200 gallons per day per square foot (gal/$(ft)^2$(day)) for maximum 24-hour flows to 2,000 to 3,000 gal/$(ft)^2$(day) for peak flows. Typical hydraulic loading for secondary clarifiers would range from 400 to 800 gal/$(ft)^2$(day) maximum 24-hour flow to 1,000 to 1,200 gal/$(ft)^2$(day) peak flow.

The variations in acceptable loading rates are a function of the nature of the raw sewage, other treatment processes in the system and designer preference. Reduction of flow to existing sedimentation basins can be readily accommodated and would be less than the typical design range. New sedimentation facilities could be designed in smaller sizes, particularly in those cases where peak wet weather flows are handled by standby facilities or stored in equalization basins.

One effect of reduced flows to existing sedimentation basins is to increase the amount of time sewage spends in that basin. The risk of settled sewage solids becoming septic, producing gas and floating to the top increases. This can be countered by maintaining a high solids removal rate from the tank bottoms and can be accomplished with existing equipment.

Suspended solids removed in primary clarifiers are considered Class II materials exhibiting unhindered settling with some floc growth over time. For such solids, particle settling velocity generally does not change with time for any class of particles. The design surface overflow rate of a primary clarifier is chosen to remove 100 percent of suspended solids with a settling velocity greater than the overflow rate and lesser percentages of solids with lower settling velocities. Designs are usually based upon 50 to 60 percent suspended solids removal. A reduction in wastewater flow of up to 20 percent would provide enhanced solids removal, the extent of which would depend upon the nature of the sewage. Bay Area sewage treatment plants achieved none to slight improvements in sedimentation processes as a result of drought induced flows. Solids collection in the clarifiers did not increase significantly.

Suspensions normally encountered in secondary clarifiers following biological treatment undergo hindered settling. Particle settling velocity decreases as solids concentration increases. As will be shown later, reduced flows are expected to require an increase in mixed liquor solids concentration and thus settling velocities in the secondary clarifier may decrease. However, the surface overflow

rate also could decrease, up to 20 percent. This would be expected to increase suspended solids removal except that secondary clarifiers are now designed to separate essentially all (99 percent) suspended solids and average performance would probably not improve. Reduced hydraulic flow could be of benefit during high flow periods when clarifier loading is greater than optional. Hydraulic turbulence, short circuiting and solids loss could be reduced.

Reduced wastewater flows accompanied by unchanging mixed liquor solids concentrations would result in less biomass loss from the aeration tank of an activated sludge facility. This can be translated to a reduction in sludge recycle pumping by a percentage equivalent to the wastewater flow reduction. Because large increases in sedimentation time produce very small increases in activated sludge density, it is not expected that recycle sludge density would be significantly increased.

TRICKLING FILTERS

Water conservation is not expected to increase total organic loading upon existing trickling filters for a given service population. However, the increased concentrations of organic pollutants (BOD) can degrade filter performance and violate an existing treatment plants' NPDES permit conditions.

Trickling filters are designed on the basis of BOD loading per volume of filter. The effect of effluent recycle is to improve treatment efficiency and within limits, permit higher loading to the filter. Geller and Gottaas concluded that for rock filters, few benefits for treatment efficiency could be obtained beyond a recycle ration of 4:1. For plastic media filters, recycle above that necessary to wet all surfaces produces little benefit.

An analysis of reduced flow effects upon trickling filter performance must be prefaced by an explanation of treatment efficiency. For a given hydraulic inflow, both the ratios of BOD mass removed to mass applied and BOD concentration reductions to concentrations applied will be identical. If the mass of BOD removed by a trickling filter (and associated clarifiers) were to remain constant for a constant influent mass, but the wastewater flows were to decrease by 20%, then the effluent quality would deteriorate unless treatment efficiency were improved. The following table illustrates this point:

INFLUENT TO BIOLOGICAL TREATMENT			EFFLUENT		Removal
Flow, mgd	BOD mass, lbs.	concentration mg/l	BOD mass, lbs.	concentration mg/l	efficiency %
2 mgd	2666	160	506	30	81
1.6	2666	200	506	38	81
1.6	2666	200	400	30	85

Because Federal law requires a secondary treatment effluent BOD_5 of 30 mg/l for municipal wastewater treatment plants, conservation reduced flows must be accompanied by increased plant efficiency in order to maintain the effluent level.

The performance of trickling filters operating at design capacity was evaluated using formulas developed by: Geller and Gottaas;

$$L_e = \frac{K(iL_i + rL_e)^{1.19}}{(i+r)^{0.78}(1+D)^{0.67}a^{0.25}} \quad \text{where: } K = \frac{0.464\left(\frac{4.3560}{\pi}\right)^{0.15}}{i^{0.28}\,T^{0.15}}$$

and;

L_e = unsettled filter effluent, 5-day, 20°C BOD, mg/l,
L_i = filter influent 5-day, 20°C BOD, mg/l,
D = filter depth, ft,
i = influent flow, mgd,
r = recirculation flow, mgd,
a = filter radius, ft, and
T = wastewater temperature, °C.

and the National Research Council;

$$E = \frac{100}{1 + 0.0085\left(\frac{W}{VF}\right)^{1/2}}$$

where;

E = percent BOD removal efficiency through the first-stage filter and settling tank,
W = BOD loading (lb/day) to the first filter, not including recycle,
V = volume of the filter in acre-ft (surface area times depth of media),
F = number of passes of the organic material, equal to

$$\frac{\left(1+\frac{r}{i}\right)}{\left(1+\frac{r}{10i}\right)^2}$$

Using the Geller and Gottaas formula, a 96 ft. diameter rock filled trickling filter with a depth of 7 feet and a recirculation ratio of 4:1 at $20^{o}C$ could produce an effluent with 30 mg/l of BOD_5 from a 2 mgd influent of 160 mg/l of BOD. Reducing the influent flow by 20 percent to 1.6 mgd theoretically would increase effluent BOD_5 to 37 mg/l. By increasing the recycle ratio to 10:1 a minimum effluent BOD_5 of 31.4 mg/l is predicted. The formula's results show that no amount of recycle could produce an effluent with a BOD of 30 mg/l, even though total organic loading to the facility would not change.

A similar result is obtained from the NRC formula where the same trickling filter, under normal loading, is calculated to produce an effluent BOD_5 of 35 mg/l. A 20 percent reduction in inflow would deteriorate effluent BOD_5 to 43.5 mg/l. In order to maintain the same mass removal efficiency the NRC formula predicts a required recycle ratio of 15:1 and also shows that no increase in recycle could produce an original effluent BOD_5 of 35 mg/l.

Thus for trickling filters operated at design capacity, water conservation is predicted to cause a deterioration in effluent quality. Newly designed trickling filters would need to be sized with a greater reactor volume to accommodate the increased influent concentration and still meet Federal standards for secondary effluent.

ACTIVATED SLUDGE

Activated sludge systems for municipal wastewaters are designed on the basis of effluent quality desired, sludge volume index, mixed liquor suspended solids, solids residence time and food to microorganism ratio. For a specified wastewater, the effluent quality, reaction rate constants, and sludge volume index will, within limits, be fixed. These will determine the mixed liquor suspended solids, solids residence time (or sludge age) and food to microorganism ratio.

In order to predict the effect water conservation would have upon an existing activated sludge reactor the following equation was used:

$$BOD_{eff} = \frac{\frac{F}{M} K_s}{k - \frac{F}{M}}$$

where: F = food utilized by microorganisms per unit time - expressed in mass of BOD_5 per day

M = microorganism mass - expressed as mixed liquor volatile suspended solids (MLVSS) mass

K_s = food concentration at which food utilized by microorganisms is one-half the maximum utilization rate - a constant for any particular wastewater - expressed in mass per volume

k = maximum rate of waste mass utilization per weight of microorganisms - a constant for any particular wastewater - expressed as a number per unit time.

Recalling that in order to achieve a constant effluent waste strength under conservation conditions, a greater treatment efficiency is needed (more food must be utilized by the microorganisms). The following equation is then solved for the required change in MLVSS:

$$\frac{\frac{F_1}{M_1} K_s}{k - \frac{F_1}{M_1}} = \frac{\frac{F_2}{M_2} K_s}{k - \frac{F_2}{M_2}} \text{ is reduced to: } \frac{M_1}{M_2} = \frac{F_1}{M_2}$$

This implies that to achieve an increased BOD_5 removal, the MLVSS must be proportionately increased. In the example shown for the trickling filter, non-conservation BOD_5 removal is 2160 lbs/day and with conservation is 2266 lbs/day. This would require a five percent increase in MLVSS in an activated sludge system. Since MLVSS mass is related to sludge age, θ_c, by the expression:

$$\frac{1}{\theta_c} = Y\frac{F}{M} - k_d$$

and the ratio of $\frac{F}{M}$ would not change

where:

Y = growth yield coefficient, expressed as MLVSS produced per mass of BOD utilized

and k_d = microorganism decay coefficent, expressed per unit time

and Y and k_d would be held constant, then:

$$\frac{\theta_{c^1}}{\theta_{c^2}} = \frac{Y\frac{F_2}{M_2} - k_d}{Y\frac{F_1}{M_1} - k_d} = 1$$

The limiting factor upon increases in MLVSS would be the separability of cell solids in the secondary clarifier. However, the total increase in suspended solids would be small (five percent or less) and the hydraulic loading rate on the secondary clarifier would be reduced. It is expected that existing activated sludge facilities could accommodate such a change. In extreme cases where the sludge volume index does not change and maximum sludge recycle capacity had been used before conservation, additional recycle capacity may be needed. Generally, because flows are reduced under conservation conditions, there should be decreased MLVSS loss from the aeration basin, resulting in a potentially reduced sludge recycle flow.

WASTE STABILIZATION LAGOONS

Waste stabilization lagoons achieve waste reductions under the influence of numerous factors additional to standard loading considerations and reaction rate constants. These include solar radiation, evaporation, cloud cover, percolation, wind strength and a particular sensitivity to air temperature. The variability of these factors, coupled with the usual variation in waste type, strength and flow have resulted in lagoon designs based upon empirical data more often than rigorous theory based upon detailed understanding of all system variables.

Gloyna presents an idealized Binetic model of BOD_5 removal in a focultative lagoon:

$$BOD_5 \text{ eff.} = \frac{BOD_5 \text{ inf.}}{K_T \, \theta_T + 1}$$

where: BOD_5 is expressed in mg/l

θ_T = detention time in days at temperature

K_T = reaction rate at temperature

The factor K_T is dependent upon all of the variables affecting lagoon performance and is reported as a range of values for typical wastes under typical conditions. Again using the example presented in the trickling filter analysis and assuming a K_T of 0.3 at 20°C, the lagoon detention time under normal waste flow conditions was calculated:

$$30 \text{ mg/l} = \frac{160 \text{ mg/}\ell}{0.3 \, \theta_T + 1}$$

and θ_T = 14.4 days.

Under water conservation conditions, the same lagoon would produce an effluent BOD_5 of:

$$BOD_5 \text{ mg/}\ell = \frac{200 \text{ mg/}\ell}{(0.3)(1.25)(14.4) + 1}$$

$$= 31.5 \text{ mg/}\ell$$

In order to achieve the same effluent quality under water conservation conditions the hydraulic detention time must be raised to:

$$30 \text{ mg/l} = \frac{200 \text{ mg/l}}{0.3\,\theta_2 + 1}$$

$$= 18.9 \text{ days.}$$

The necessary increased in lagoon volume would be:

$$\frac{\theta_1}{\theta_2} = \frac{14.4}{18.9} = \frac{V_1 Q_2}{V_2 Q_1} = \frac{V_1}{V_2}(0.8)$$

$$V_2 = 0.8\, V_1 \left(\frac{18.9}{14.4}\right) = 1.05\, V_1$$

Since evaporation and percolation losses are likely to be higher at the lower flow, longer retention time conditions, it is possible that no increase in lagoon volume may be necessary and even a decrease may be obtained.

CHEMICAL TREATMENT

Chemical treatment of wastewater is usually performed in conjunction with sedimentation or filtration processes, with the primary objective of suspended solids or phosphate removal. Treatment of wastewater with lime, alum, or ferrous sulfate and lime for solids removal depends on carbonate and bicarbonate alkalinity for the formation of an insoluble floc. The use of ferric chloride does not depend upon wastewater alkalinity.

For phosphorus precipitation, the addition of aluminum or ferric iron is dependent primarily upon wastewater pH and phosphate concentration. Lime addition for phosphate removal must be in excess of the alkalinity demand of the wastewater.

As was shown earlier, reduced wastewater flows require increased removals of pollutants in order to maintain effluent quality. Theoretically, increased alum or iron dosage would be needed for phosphorus removal. Practically, because of inherent variability in wastewater characteristics, chemical dosing is conservatively overdesigned and should not be significantly adjusted for reduced flow. However, stoichiometric equations cannot accurately predict appropriate chemical dosages due to numerous competing reactions. Only bench scale testing can verify the predicted effect of reduced flows on phosphorus removal.

Suspended solids removal by chemical precipitation and phosphorus removal by lime addition are dependent upon wastewater alkalinity and quantity. Typical total carbonate and bicarbonate alkalinity of freshwater in the East Bay Municipal Utility District is 20 mg/l while that of corresponding primary settled effluent is 120 to 130 mg/l. Therefore, approximately 85 percent of wastewater alkalinity is due to added waste or groundwater constituents. A 20 percent reduction in residential wastewater flow theoretically should result in only a 3 percent reduction in chemical dosing requirements. Again, only bench scale testing can accurately establish the new chemical dosing requirements. It is unclear what the effect would be on removal efficiency.

GRANULAR MEDIA WASTEWATER FILTRATION

Wastewater filtration processes are often sized on the basis of water quantity handled. However, the service capacity of a filter is determined by the solids retention capacity, i.e., how rapidly solids block voids in the filter materials. Ultimate failure or capacity of a filter is reached when hydraulic headloss through the filter reaches available head.

In the filtration of clean water, the filter headloss is proportional to the square of the water velocity or loading rate, expressed in gpm/ft^2. Additional headloss is associated with the filling of voids, or, for a particular media, reduction in solids holding capacity. The total head loss experienced through a filter is the sum of hydraulic head plus head due to solids buildup. If wastewater flows were to be reduced up to 20 percent on an existing filter, the hydraulic head loss would be reduced. This would allow an increase in solids storage and associated head losses, resulting in longer filter runs between backwashes. This would be true even if the total solids mass load to the filter were unchanged.

The solids storage capacity and solids removal efficiency is most dependent upon the nature of the wastewater solids and the size of the filter media. Filter media size is selected to capture all suspended solids above a certain diameter within a certain filter depth and head loss. Increased pressures can drive suspended solids through the filter by increasing shear force on the particles. However, for a given design head and filter depth, only suspended solids below a certain size would appear in the filtrate. Even these solids would be removed to some extent within the filter as a result of void bridging by larger particles. Reduced wastewater flows due to conservation should still result in passage of the same size particles. Whether the reduced shear forces will account for increased small particle removal by bridging cannot be accurately predicted. However, in the design of a new granular media filter, the reduced clean water hydraulic head losses can be used to offset a smaller size media, giving improved suspended solids removal for an equivalently sized filter. This is essential to maintain a fixed effluent solids concentration.

DISINFECTION

Disinfection of treated municipal wastewaters is usually accomplished by the addition of chlorine. An empirical equation presents the effect of concentration of chlorine, or any other disinfectant, upon bacterial destruction:

$$C^n t = \text{constant } K$$

where: C = concentration of disinfectant

n, K = Constants dependent upon nature of disinfectant, organisms, pH, temperature and wastewater quality

t = contact time for a specific percentage bacterial kill

When wastewater flows are reduced through conservation by up to 20 percent and the effluent quality has not deteriorated, improved bacterial kill can be expected at a certain chlorine concentration. This is because contact time would increase by up to 25 percent. Equivalent destruction of bacteria could be accomplished in an existing facility by reducing the chlorine dosage. The reduction in specific chlorine dosage generally should not be linearly proportional to the increase in contact time because chlorination of wastewaters produces chloramimes which are less effective in disinfection than hypochlorous acid or hypochlorite ion. Changing specific chlorine dosage would be tantamount to changing the proportion of chlorine species (each with different disinfection qualities) in the water. However, the total chlorine supplied on a daily basis can be expected to decrease.

Presently, the preferred method for chlorine dosage control involves two control loops. One loop measures wastewater flow to control the chlorine metering orifice and the other measures chlorine residual to control the vacuum regulating valve. Reduced wastewater flows as a result of water conservation should proportionately decrease chlorine usage. Unless the dissolved chlorine residual is also decreased in response to an increased contact time, no further chlorine savings are expected.

SEWAGE SLUDGE SOLIDS HANDLING

The total mass of pollutants in raw wastewater should not change as a result of moderate water conservation programs. However, it was shown that effluent quality requirements placed upon reduced flows necessitate increased removals of those pollutants. For a typical municipal activated sludge treatment facility, sewage sludge is produced in two unit processes: primary sedimentation and biological stabilization. Approximately 60 percent, by weight, of sludge comes from primary sedimentation and 40 percent from waste activated sludge.

It is not possible to predict the increase in primary sludge production resulting from reduced hydraulic flows through existing clarifiers. This increase is highly dependent upon the nature of the specific wastewater and the design of the clarifier but should not be very large.

The necessity for increased BOD_5 removal can be used to estimate an increase in waste activated sludge. From the example shown earlier, an additional 106 lbs. of BOD_5 must be removed from a 1.6 mgd wastewater. This could produce approximately 53 lbs. of excess cell solids for wasting. Neglecting possible increased solids removals in the primary clarifier, total sludge production would increase on the order of 1.5 percent by weight.

Facilities needed to handle sewage sludge include, among others, pumps, digesters, chemical conditioners, vacuum filters, centrifuges, incinerators, filter presses, thickening tanks, drying beds and landfill capacity. The analysis indicates that these facilities would not be significantly affected as a result of water conservation programs.

FACILITY COSTS

Table 2 presents a summary of the expected effects of water conservation programs upon wastewater treatment unit processes. Also included in the Table is a column showing the relative capital cost of each unit process found in a conventional activated sludge facility.

All of the processes in an activated sludge facility would be affected by water conservation. Processes accounting for 40 percent of total facility cost may be reduced in size. These processes, generally sized on the basis of hydraulic loading, could ideally be decreased in size by 20 percent with a 20 percent reduction in wastewater flow. If the need exists to treat stormwater inflow amounting to 70 percent of the average dry weather flow rate (ADWF) and the facility has an ADWF peaking factor of 2.5, then only a 15 percent capacity reduction may be achievable.

The biological stabilization unit and sludge processing units would need a theoretical increase in capacity of five and 1.5 + percent respectively. These units are designed on the basis of organic or solids removal, which must be increased for improved facility performance.

Sewers might be reduced in size if improved construction techniques could materially reduce stormwater inflow.

Should reduction in unit process sizes be achievable, then some cost savings may be realized. Economies of scale produce non-linearities of cost to size relationships. For a 10 mgd facility, unit size changes of 20, 15, 5 and 1.5 percent produce corresponding construction cost changes of approximately 12, 9, 3 and 1 percent.

TABLE 2

WASTEWATER TREATMENT UNIT PROCESSES AFFECTED BY WATER CONSERVATION

Unit	Population Capacity Change in Existing Facility	Affect on Size In New Facility	Percent of Capital Cost for 30-mgd Activated Sludge Facility
Sewers	Increase	Decrease	not included
Headworks	Increase	Decrease	18
Primary sedimentation	Increase	Decrease	8
Biological	Very Slight Decrease	Very Slight Increase	22 (activated sludge)
Secondary sedimentation	Increase	Decrease	10
Chemical treatment	Varies, insignificant	Varies, insignificant	not included
Filtration	Increase	Possible decrease	not included
Disinfection	Increase	Decrease	4
Sludge handling	Decrease, insignficant	Increase, insignificant	34
Administration/ maintenance	No change	No change	4

If we allow for treatment of stormwater inflows, then hydraulically sized units would be reduced in size a maximum of 15 percent under our assumptions. The sum of increased and decreased unit process construction costs would add up to a net maximum saving of 2.5 percent. If unit process treatment efficiencies require improved solids removals from sedimentation basins then construction savings may be somewhat less. If improved biological treatment efficiency can be accommodated with the design "slop" for such processes, then construction savings may be increased one percent.

The factor that most changes the sizing of various processes designed on the basis of flow is not water conservation but stormwater inflow and other groundwater infiltration. The techniques used to control inflow, or to treat the inflow that cannot be economically reduced, may vary significantly among sewerage districts. Each wastewater treatment facility must be separately evaluated for potential size reductions or additional capacity resulting from water conservation in light of the specific peak wet weather management techniques used at that facility.

Cost savings due to size reductions of sewers must be calculated for each case. Sewers are purchased in certain size increments and only in marginal cases would the flow reductions have an effect upon choice of size. A large portion of sewerage costs is the cost of installation which would not vary significantly for incremental sewer size changes.

With regard to the effects of flow reductions on existing facilities the following points must be made. No benefits are expected for two critical processes: biological stabilization and sludge solids handling. If these processes in a specific facility are approaching their maximum design capacity, then the additional plant loading made possible by extra hydraulic capacity in other unit processes should not be utilized. Overloading the biological stabilization process or sludge handling facilities could detrimentally affect facility performance. Since these two processes and disinfection account for approximately 60 percent of a facility's capital cost, expansion of their capacities would probably be done as part of a total facility expansion.

APPENDIX A

WASTEWATER FLOW PROJECTIONS BY SEWERAGE UNIT

(Current as of 15 November 1977)

APPENDIX TABLE A1: BASE CASE1 WASTEWATER FLOW PROJECTIONS FOR 1980

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	10315	85.00	.88	0.00	.88	79.13	.82	0.00	.82
2	15014	90.00	1.35	0.00	1.35	83.88	1.26	0.00	1.26
3	8026	100.00	.80	0.00	.80	93.38	.75	0.00	.75
4	17388	85.00	1.48	0.00	1.48	79.13	1.38	0.00	1.38
5	54620	85.00	4.64	0.00	4.64	79.13	4.32	0.00	4.32
6	34043	122.00	4.15	0.00	4.15	114.28	3.89	0.00	3.89
7	27422	80.00	2.19	0.00	2.19	74.38	2.04	0.00	2.04
8	47890	90.00	4.31	0.00	4.31	83.88	4.02	0.00	4.02
9	40710	100.00	4.07	0.00	4.07	93.38	3.80	0.00	3.80
10	21612	100.00	2.16	0.00	2.16	93.38	2.02	0.00	2.02
11	55138	100.00	5.51	.30	5.81	93.38	5.15	.29	5.43
12	77682	100.00	7.77	.50	8.27	93.38	7.25	.47	7.73
13	11883	85.00	1.01	.40	1.41	79.13	.94	.38	1.32
14	63390	100.00	8.34	3.20	11.54	93.38	7.92	3.04	10.96
15	8285	85.00	.70	0.00	.70	79.13	.66	0.00	.66
16	33686	80.00	2.69	.08	2.77	74.38	2.51	.08	2.58
17	33965	85.00	2.89	.95	3.84	79.13	2.69	.90	3.59
18	345893	103.00	35.63	0.00	35.63	96.23	33.29	0.00	33.29
19	3730	100.00	.37	0.00	.37	93.38	.35	0.00	.35
20	11117	100.00	1.11	0.00	1.11	93.38	1.04	0.00	1.04
21	19730	100.00	1.97	0.00	1.97	93.38	1.84	0.00	1.84
22	63043	100.00	6.30	.43	6.73	93.38	5.89	.41	6.30
23	49994	100.00	5.00	1.81	6.81	93.38	4.67	1.72	6.39
24	574548	113.00	64.92	11.30	76.22	105.73	60.75	10.73	71.48
25	44545	80.30	3.58	3.50	7.08	74.67	3.33	3.32	6.65
26	135450	90.10	12.20	.50	12.70	83.98	11.38	.47	11.85
27	111883	102.00	11.41	7.20	18.61	95.28	10.66	6.84	17.50
30	198215	78.50	15.56	2.30	17.86	72.96	14.46	2.18	16.65
31	47262	93.20	4.40	.30	4.70	86.92	4.11	.29	4.39
32	68192	90.00	6.14	1.30	7.44	83.88	5.72	1.23	6.96
33	932985	100.00	93.30	41.80	135.10	93.38	87.13	39.71	126.84
34	105259	100.00	10.53	7.50	18.03	93.38	9.83	7.12	16.95
35	178317	100.00	18.83	6.90	25.73	93.38	17.65	6.55	24.21
36	49335	85.70	5.23	.60	5.83	79.80	4.94	.57	5.51
37	79976	89.70	7.97	1.00	8.97	83.60	7.49	.95	8.44
38	51148	83.30	4.26	1.00	5.26	77.52	3.96	.95	4.91
39	25833	80.00	2.27	0.00	2.27	74.38	2.12	0.00	2.12
40	95357	100.00	11.24	0.00	11.24	93.38	10.60	0.00	10.60
41	30916	100.00	3.09	.40	3.49	93.38	2.89	.38	3.27
42	20801	100.00	2.08	0.00	2.08	93.38	1.94	0.00	1.94
43	77622	92.00	8.14	1.30	9.44	85.78	7.66	1.23	8.89
44	24998	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	14277	85.00	1.51	0.00	1.51	79.13	1.43	0.00	1.43
46	47424	85.00	4.03	0.00	4.03	79.13	3.75	0.00	3.75
47	76696	94.00	7.21	0.00	7.21	87.68	6.73	0.00	6.73
48	153057	90.00	18.82	4.40	23.22	83.88	17.74	4.18	21.92
49	300521	163.00	59.38	4.70	64.08	153.23	56.45	4.46	60.92
50	206901	87.00	19.40	1.20	20.60	81.03	18.17	1.14	19.31
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	4758321		501	105	606		469	100	569

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A2: BASECASE 1 WASTEWATER FLOW PROJECTIONS FOR 1985

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	11219	85.00	.95	0.00	.95	77.99	.88	0.00	.88
2	16401	90.00	1.48	0.00	1.48	82.69	1.36	0.00	1.36
3	8463	100.00	.85	0.00	.85	92.65	.78	0.00	.78
4	17436	85.00	1.48	0.00	1.48	79.10	1.38	0.00	1.38
5	56291	85.00	4.78	0.00	4.78	78.71	4.43	0.00	4.43
6	35160	122.00	4.29	0.00	4.29	113.84	4.00	0.00	4.00
7	27206	80.00	2.18	0.00	2.18	74.38	2.02	0.00	2.02
8	51794	90.00	4.66	0.00	4.66	82.82	4.29	0.00	4.29
9	48519	100.00	4.85	0.00	4.85	91.11	4.42	0.00	4.42
10	24777	100.00	2.48	0.00	2.48	91.58	2.27	0.00	2.27
11	56709	100.00	5.67	.30	5.97	92.99	5.27	.29	5.56
12	81982	100.00	8.20	.50	8.70	92.64	7.60	.47	8.07
13	15992	85.00	1.36	.50	1.86	75.50	1.21	.47	1.68
14	69917	100.00	8.99	3.40	12.39	92.06	8.44	3.23	11.67
15	9318	85.00	.79	0.00	.79	77.57	.72	0.00	.72
16	34739	80.00	2.78	.09	2.87	73.96	2.57	.09	2.65
17	35460	85.00	3.01	1.10	4.11	78.54	2.78	1.04	3.83
18	382422	103.00	39.39	0.00	39.39	94.88	36.29	0.00	36.29
19	3734	100.00	.37	0.00	.37	93.37	.35	0.00	.35
20	15773	100.00	1.58	0.00	1.58	89.21	1.41	0.00	1.41
21	26669	100.00	2.67	0.00	2.67	89.70	2.39	0.00	2.39
22	69153	100.00	6.92	.48	7.40	92.13	6.37	.46	6.83
23	48636	100.00	4.86	1.86	6.72	93.38	4.54	1.77	6.31
24	568911	113.00	64.29	11.30	75.59	105.73	60.15	10.73	70.89
25	43309	80.30	3.48	3.50	6.98	74.67	3.23	3.32	6.56
26	137333	90.10	12.37	.50	12.87	83.79	11.51	.47	11.98
27	124166	102.00	12.66	7.20	19.86	93.88	11.66	6.84	18.50
30	229777	78.50	18.04	2.30	20.34	71.02	16.32	2.18	18.50
31	48126	93.20	4.49	.30	4.79	86.67	4.17	.29	4.46
32	82746	90.00	7.45	1.30	8.75	81.40	6.74	1.23	7.97
33	1011226	100.00	101.12	42.90	144.02	92.29	93.33	40.75	134.08
34	101884	100.00	10.19	9.00	19.19	93.38	9.51	8.55	18.06
35	182392	100.00	19.24	6.90	26.14	93.07	17.97	6.55	24.53
36	48619	85.70	5.17	.60	5.77	79.80	4.88	.57	5.45
37	84268	89.70	8.36	1.00	9.36	82.88	7.78	.95	8.73
38	51438	83.30	4.28	1.00	5.28	77.44	3.98	.95	4.93
39	29644	80.00	2.57	0.00	2.57	72.57	2.35	0.00	2.35
40	110212	100.00	12.72	0.00	12.72	91.48	11.78	0.00	11.78
41	30285	100.00	3.03	.40	3.43	93.38	2.83	.38	3.21
42	20138	100.00	2.01	0.00	2.01	93.38	1.88	0.00	1.88
43	74920	92.00	7.89	1.30	9.19	85.78	7.43	1.23	8.66
44	25001	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	20418	85.00	2.04	0.00	2.04	74.88	1.83	0.00	1.83
46	57775	85.00	4.91	0.00	4.91	76.60	4.43	0.00	4.43
47	75471	94.00	7.09	0.00	7.09	87.68	6.62	0.00	6.62
48	147553	90.00	18.33	4.30	22.63	83.88	17.27	4.08	21.36
49	297499	163.00	58.89	4.50	63.39	153.23	55.99	4.27	60.26
50	201493	87.00	18.93	1.20	20.13	81.03	17.73	1.14	18.87
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	5003622		524	108	632		487	102	589

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A3: BASE CASE 1 WASTEWATER FLOW PROJECTIONS FOR 1990

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	13656	85.00	1.16	0.00	1.16	75.67	1.03	0.00	1.03
2	18974	90.00	1.71	0.00	1.71	80.93	1.54	0.00	1.54
3	9817	100.00	.98	0.00	.98	90.80	.89	0.00	.89
4	19289	85.00	1.64	0.00	1.64	77.74	1.50	0.00	1.50
5	60623	85.00	5.15	0.00	5.15	77.73	4.71	0.00	4.71
6	35285	122.00	4.30	0.00	4.30	13.79	4.01	0.00	4.01
7	35265	80.00	2.82	0.00	2.82	71.24	2.51	0.00	2.51
8	74330	90.00	6.69	0.00	6.69	78.85	5.86	0.00	5.86
9	56142	100.00	5.61	0.00	5.61	89.49	5.02	0.00	5.02
10	28198	100.00	2.82	0.00	2.82	90.08	2.54	0.00	2.54
11	59224	100.00	5.92	.30	6.22	92.41	5.47	.29	5.76
12	93401	100.00	9.34	.50	9.84	91.00	8.50	.47	8.97
13	27097	85.00	2.30	.50	2.80	71.19	1.93	.47	2.40
14	77302	100.00	9.73	3.50	13.23	90.84	9.02	3.32	12.35
15	12339	85.00	1.05	0.00	1.05	74.48	.92	0.00	.92
16	37146	80.00	2.97	.10	3.07	73.07	2.71	.09	2.81
17	41898	85.00	3.56	1.16	4.72	76.45	3.20	1.10	4.31
18	432030	103.00	44.50	0.00	44.50	93.41	40.36	0.00	40.36
19	4460	100.00	.45	0.00	.45	91.07	.41	0.00	.41
20	18683	100.00	1.87	0.00	1.87	87.65	1.64	0.00	1.64
21	31375	100.00	3.14	0.00	3.14	88.13	2.77	0.00	2.77
22	70846	100.00	7.08	.50	7.58	91.83	6.51	.47	6.98
23	51258	100.00	5.13	1.90	7.03	93.04	4.77	1.80	6.57
24	576937	113.00	65.19	11.30	76.49	105.68	60.97	10.73	71.70
25	43243	80.30	3.47	3.50	6.97	74.67	3.23	3.32	6.55
26	136670	90.10	12.31	.50	12.81	83.85	11.46	.47	11.94
27	131891	102.00	13.45	7.20	20.65	93.14	12.28	6.84	19.12
30	222891	78.50	17.50	2.30	19.80	71.39	15.91	2.18	18.10
31	62955	93.20	5.87	.30	6.17	83.40	5.25	.29	5.54
32	90568	90.00	8.15	1.30	9.45	80.39	7.28	1.23	8.52
33	1009369	100.00	100.94	43.90	144.84	92.31	93.18	41.70	134.88
34	99212	100.00	9.92	9.00	18.92	93.38	9.26	8.55	17.81
35	183095	100.00	19.31	6.90	26.21	93.02	18.03	6.55	24.59
36	56149	85.70	5.81	.60	6.41	78.08	5.38	.57	5.95
37	86261	89.70	8.54	1.00	9.54	82.57	7.92	.95	8.87
38	50721	83.30	4.23	1.00	5.23	77.52	3.93	.95	4.88
39	28828	80.00	2.51	0.00	2.51	72.91	2.30	0.00	2.30
40	111804	100.00	12.88	0.00	12.88	91.30	11.91	0.00	11.91
41	33514	100.00	3.35	.40	3.75	92.29	3.09	.38	3.47
42	20041	100.00	2.00	0.00	2.00	93.38	1.87	0.00	1.87
43	73085	92.00	7.72	1.30	9.02	85.78	7.27	1.23	8.50
44	29648	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	27356	85.00	2.63	0.00	2.63	72.37	2.28	0.00	2.28
46	60226	85.00	5.12	0.00	5.12	76.13	4.58	0.00	4.58
47	75506	94.00	7.10	0.00	7.10	87.68	6.62	0.00	6.62
48	143748	90.00	18.41	4.20	22.61	83.51	17.28	3.99	21.27
49	302543	163.00	59.71	4.30	64.01	153.14	56.73	4.08	60.82
50	196945	87.00	18.53	1.20	19.73	81.03	17.36	1.14	18.50
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	5211636		545	109	653		503	103	606

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A4: BASE CASE 1 WASTEWATER FLOW PROJECTIONS FOR 1995

		NORMAL FLOWS				WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	13462	85.00	1.14	0.00	1.14	75.83	1.02	0.00	1.02
2	19691	90.00	1.77	0.00	1.77	80.52	1.59	0.00	1.59
3	9659	100.00	.97	0.00	.97	90.99	.88	0.00	.88
4	19325	85.00	1.64	0.00	1.64	77.72	1.50	0.00	1.50
5	61452	85.00	5.22	0.00	5.22	77.56	4.77	0.00	4.77
6	35067	122.00	4.28	0.00	4.28	113.87	3.99	0.00	3.99
7	35045	80.00	2.80	0.00	2.80	71.31	2.50	0.00	2.50
8	80906	90.00	7.28	0.00	7.28	78.11	6.32	0.00	6.32
9	63849	100.00	6.38	0.00	6.38	88.26	5.64	0.00	5.64
10	33877	100.00	3.39	0.00	3.39	88.26	2.99	0.00	2.99
11	64665	100.00	6.47	.30	6.77	91.30	5.90	.29	6.19
12	95864	100.00	9.59	.50	10.09	90.70	8.69	.47	9.17
13	26810	85.00	2.28	.60	2.88	71.25	1.91	.57	2.48
14	90608	100.00	11.06	3.60	14.66	89.13	10.08	3.42	13.50
15	17572	85.00	1.49	0.00	1.49	71.65	1.26	0.00	1.26
16	40919	80.00	3.27	.11	3.38	71.88	2.94	.10	3.05
17	43773	85.00	3.72	1.23	4.95	75.96	3.33	1.17	4.49
18	435451	103.00	44.85	0.00	44.85	93.32	40.64	0.00	40.64
19	4386	100.00	.44	0.00	.44	91.27	.40	0.00	.40
20	20224	100.00	2.02	0.00	2.02	87.01	1.76	0.00	1.76
21	32223	100.00	3.22	0.00	3.22	87.90	2.83	0.00	2.83
22	71541	100.00	7.15	.52	7.67	91.70	6.56	.49	7.05
23	52444	100.00	5.24	1.95	7.19	92.72	4.86	1.85	6.72
24	623557	113.00	70.46	11.30	81.76	104.62	65.24	10.73	75.97
25	48374	80.30	3.88	3.50	7.38	73.55	3.56	3.32	6.88
26	135457	90.10	12.20	.50	12.70	83.98	11.38	.47	11.85
27	131249	102.00	13.39	7.20	20.59	93.20	12.23	6.84	19.07
30	219576	78.50	17.24	2.30	19.54	71.58	15.72	2.18	17.90
31	63888	93.20	5.95	.30	6.25	83.24	5.32	.29	5.60
32	89183	90.00	8.03	1.40	9.43	80.55	7.18	1.33	8.51
33	1041200	100.00	104.12	45.00	149.12	91.91	95.70	42.75	138.45
34	99147	100.00	9.91	9.00	18.91	93.38	9.26	8.55	17.81
35	190534	100.00	20.05	6.90	26.95	92.48	18.62	6.55	25.18
36	58107	85.70	5.98	.60	6.58	77.66	5.51	.57	6.08
37	87455	89.70	8.64	1.00	9.64	82.39	8.01	.95	8.96
38	51632	83.30	4.30	1.00	5.30	77.39	4.00	.95	4.95
39	28432	80.00	2.47	0.00	2.47	73.09	2.28	0.00	2.28
40	139089	100.00	15.61	0.00	15.61	88.93	14.07	0.00	14.07
41	55778	100.00	5.58	.40	5.98	87.08	4.86	.38	5.24
42	21780	100.00	2.18	0.00	2.18	92.75	2.02	0.00	2.02
43	73264	92.00	8.24	1.30	9.54	85.78	7.78	1.23	9.02
44	29456	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	26919	85.00	2.59	0.00	2.59	72.49	2.25	0.00	2.25
46	67055	85.00	5.70	0.00	5.70	74.99	5.03	0.00	5.03
47	82903	94.00	7.79	0.00	7.79	86.63	7.18	0.00	7.18
48	142231	90.00	18.25	4.20	22.45	83.52	17.14	3.99	21.13
49	315029	163.00	61.75	4.20	65.95	152.58	58.47	3.99	62.46
50	194941	87.00	18.36	1.20	19.56	81.03	17.20	1.14	18.34
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	5434680		568	110	678		522	105	627

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A3: BASE CASE 1 WASTEWATER FLOW PROJECTIONS FOR 2000

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	13287	85.00	1.13	0.00	1.13	75.97	1.01	0.00	1.01
2	20504	90.00	1.85	0.00	1.85	80.09	1.64	0.00	1.64
3	9519	100.00	.95	0.00	.95	91.16	.87	0.00	.87
4	19569	85.00	1.66	0.00	1.66	77.56	1.52	0.00	1.52
5	62747	85.00	5.33	0.00	5.33	77.30	4.85	0.00	4.85
6	35047	122.00	4.28	0.00	4.28	113.88	3.99	0.00	3.99
7	34761	80.00	2.78	0.00	2.78	71.40	2.48	0.00	2.48
8	86056	90.00	7.75	0.00	7.75	77.61	6.68	0.00	6.68
9	71524	100.00	7.15	0.00	7.15	87.29	6.24	0.00	6.24
10	40974	100.00	4.10	0.00	4.10	86.70	3.55	0.00	3.55
11	71137	100.00	7.11	.30	7.41	90.20	6.42	.29	6.70
12	98908	100.00	9.89	.50	10.39	90.35	8.94	.47	9.41
13	26503	85.00	2.25	.60	2.85	71.33	1.89	.57	2.46
14	102148	100.00	12.21	3.70	15.91	88.01	10.99	3.51	14.51
15	23263	85.00	1.98	0.00	1.98	70.02	1.63	0.00	1.63
16	44666	80.00	3.57	.11	3.68	70.91	3.17	.10	3.27
17	45523	85.00	3.87	1.27	5.14	75.54	3.44	1.21	4.65
18	430974	103.00	44.39	0.00	44.39	93.44	40.27	0.00	40.27
19	4320	100.00	.43	0.00	.43	91.45	.40	0.00	.40
20	21430	100.00	2.14	0.00	2.14	86.57	1.86	0.00	1.86
21	34003	100.00	3.40	0.00	3.40	87.44	2.97	0.00	2.97
22	71522	100.00	7.15	.57	7.72	91.71	6.56	.54	7.10
23	54689	100.00	5.47	2.00	7.47	92.17	5.04	1.90	6.94
24	663989	113.00	75.03	11.30	86.33	103.83	68.94	10.73	79.68
25	54106	80.30	4.34	3.50	7.84	72.17	3.90	3.32	7.23
26	134613	90.10	12.13	.50	12.63	83.98	11.30	.47	11.78
27	131178	102.00	13.38	7.20	20.58	93.20	12.23	6.84	19.07
30	216620	78.50	17.00	2.30	19.30	71.76	15.54	2.18	17.73
31	62979	93.20	5.87	.30	6.17	83.39	5.25	.29	5.54
32	87963	90.00	7.92	1.40	9.32	80.70	7.10	1.33	8.43
33	1068891	100.00	106.89	46.00	152.89	91.59	97.89	43.70	141.59
34	99559	100.00	9.96	9.00	18.96	93.38	9.30	8.55	17.85
35	200690	100.00	21.07	6.90	27.97	91.81	19.42	6.55	25.98
36	58370	85.70	6.00	.60	6.60	77.61	5.53	.57	6.10
37	89246	89.70	8.81	1.00	9.81	82.13	8.13	.95	9.08
38	52940	83.30	4.41	1.00	5.41	77.04	4.08	.95	5.03
39	28074	80.00	2.45	0.00	2.45	73.26	2.26	0.00	2.26
40	171938	100.00	18.89	0.00	18.89	87.08	16.67	0.00	16.67
41	79738	100.00	7.97	.40	8.37	84.72	6.76	.38	7.14
42	23805	100.00	2.38	0.00	2.38	91.60	2.18	0.00	2.18
43	73321	92.00	8.25	1.30	9.55	85.78	7.79	1.23	9.02
44	29239	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	26533	85.00	2.56	0.00	2.56	72.60	2.23	0.00	2.23
46	69089	85.00	5.87	0.00	5.87	74.70	5.16	0.00	5.16
47	87073	94.00	8.18	0.00	8.18	86.00	7.49	0.00	7.49
48	141020	90.00	18.12	4.00	22.12	83.53	17.02	3.80	20.82
49	330214	163.00	64.22	4.00	68.22	151.96	60.58	3.80	64.38
50	193278	87.00	18.22	1.20	19.42	81.03	17.06	1.14	18.20
TOTALS (S.U. 1-50, SEWERED POP. ONLY)									
	5645942		591	111	702		540	105	646

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28, 29, AND 30

PPENDIX TABLE A6: BASE CASE 2 WASTEWATER FLOW PROJECTIONS FOR 1980

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	10470	85.00	.89	0.00	.89	79.13	.83	0.00	.83
2	15039	90.00	1.35	0.00	1.35	83.88	1.26	0.00	1.26
3	7914	100.00	.79	0.00	.79	93.38	.74	0.00	.74
4	17077	85.00	1.45	0.00	1.45	79.13	1.35	0.00	1.35
5	53572	85.00	4.55	0.00	4.55	79.13	4.24	0.00	4.24
6	33486	122.00	4.09	0.00	4.09	114.28	3.83	0.00	3.83
7	26736	80.00	2.14	0.00	2.14	74.38	1.99	0.00	1.99
8	45357	90.00	4.08	0.00	4.08	83.88	3.80	0.00	3.80
9	36166	100.00	3.62	0.00	3.62	93.38	3.38	0.00	3.38
10	20207	100.00	2.02	0.00	2.02	93.38	1.89	0.00	1.89
11	53385	100.00	5.34	.30	5.64	93.38	4.99	.29	5.27
12	75909	100.00	7.59	.50	8.09	93.38	7.09	.47	7.56
13	12037	85.00	1.02	.40	1.42	79.13	.95	.38	1.33
14	61613	100.00	8.16	3.20	11.36	93.38	7.75	3.04	10.79
15	8058	85.00	.68	0.00	.68	79.13	.64	0.00	.64
16	32908	80.00	2.63	.08	2.71	74.38	2.45	.08	2.52
17	33198	85.00	2.82	.95	3.77	79.13	2.63	.90	3.53
18	345358	103.00	35.57	0.00	35.57	96.23	33.24	0.00	33.24
19	3639	100.00	.36	0.00	.36	93.38	.34	0.00	.34
20	11533	100.00	1.15	0.00	1.15	93.38	1.08	0.00	1.08
21	20122	100.00	2.01	0.00	2.01	93.38	1.88	0.00	1.88
22	62531	100.00	6.25	.43	6.68	93.38	5.84	.41	6.25
23	48503	100.00	4.85	1.81	6.66	93.38	4.53	1.72	6.25
24	562920	113.00	63.61	11.30	74.91	105.73	59.52	10.73	70.26
25	43378	80.30	3.48	3.50	6.98	74.67	3.24	3.32	6.56
26	133158	90.10	12.00	.50	12.50	83.98	11.18	.47	11.66
27	111909	102.00	11.41	7.20	18.61	95.28	10.66	6.84	17.50
30	198522	78.50	15.58	2.30	17.88	72.96	14.48	2.18	16.67
31	46104	93.20	4.30	.30	4.60	86.92	4.01	.29	4.29
32	68573	90.00	6.17	1.30	7.47	83.88	5.75	1.23	6.99
33	927794	100.00	92.78	41.80	134.58	93.38	86.64	39.71	126.35
34	101918	100.00	10.19	7.50	17.69	93.38	9.52	7.12	16.64
35	175931	100.00	18.59	6.90	25.49	93.38	17.43	6.55	23.98
36	48220	85.70	5.13	.60	5.73	79.80	4.85	.57	5.42
37	79197	89.70	7.90	1.00	8.90	83.60	7.42	.95	8.37
38	50290	83.30	4.19	1.00	5.19	77.52	3.90	.95	4.85
39	26071	80.00	2.29	0.00	2.29	74.38	2.14	0.00	2.14
40	96468	100.00	11.35	0.00	11.35	93.38	10.71	0.00	10.71
41	30300	100.00	3.03	.40	3.43	93.38	2.83	.38	3.21
42	20353	100.00	2.04	0.00	2.04	93.38	1.90	0.00	1.90
43	76005	92.00	7.99	1.30	9.29	85.78	7.52	1.23	8.76
44	25016	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	14746	85.00	1.55	0.00	1.55	79.13	1.47	0.00	1.47
46	48608	85.00	4.13	0.00	4.13	79.13	3.85	0.00	3.85
47	76164	94.00	7.16	0.00	7.16	87.68	6.68	0.00	6.68
48	147861	90.00	18.36	4.40	22.76	83.88	17.30	4.18	21.48
49	294008	163.00	58.32	4.70	63.02	153.23	55.45	4.46	59.92
50	203689	87.00	19.12	1.20	20.32	81.03	17.91	1.14	19.05
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	4692785		494	105	599		463	100	563

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A7: BASE CASE 2 WASTEWATER FLOW PROJECTIONS FOR 1985

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	10921	85.00	.93	0.00	.93	78.55	.86	0.00	.86
2	16001	90.00	1.44	0.00	1.44	83.03	1.33	0.00	1.33
3	9292	100.00	.93	0.00	.93	91.29	.85	0.00	.85
4	16951	85.00	1.44	0.00	1.44	79.13	1.34	0.00	1.34
5	55108	85.00	4.68	0.00	4.68	78.74	4.34	0.00	4.34
6	34826	122.00	4.25	0.00	4.25	113.74	3.96	0.00	3.96
7	26789	80.00	2.14	0.00	2.14	74.36	1.99	0.00	1.99
8	49597	90.00	4.46	0.00	4.46	82.67	4.10	0.00	4.10
9	41330	100.00	4.13	0.00	4.13	91.62	3.79	0.00	3.79
10	22659	100.00	2.27	0.00	2.27	91.85	2.08	0.00	2.08
11	53982	100.00	5.40	.30	5.70	93.23	5.03	.29	5.32
12	78596	100.00	7.86	.50	8.36	92.90	7.30	.47	7.78
13	15783	85.00	1.34	.50	1.84	75.78	1.20	.47	1.67
14	66744	100.00	8.67	3.40	12.07	92.30	8.16	3.23	11.39
15	8883	85.00	.76	0.00	.76	77.82	.69	0.00	.69
16	33240	80.00	2.66	.09	2.75	74.24	2.47	.09	2.55
17	33958	85.00	2.89	1.10	3.99	78.82	2.68	1.04	3.72
18	380015	103.00	39.14	0.00	39.14	94.94	36.08	0.00	36.08
19	3579	100.00	.36	0.00	.36	93.38	.33	0.00	.33
20	15704	100.00	1.57	0.00	1.57	89.63	1.41	0.00	1.41
21	26346	100.00	2.63	0.00	2.63	90.04	2.37	0.00	2.37
22	68125	100.00	6.81	.48	7.29	92.22	6.28	.46	6.74
23	46323	100.00	4.63	1.86	6.49	93.38	4.33	1.77	6.09
24	544352	113.00	61.51	11.30	72.81	105.73	57.56	10.73	68.29
25	41507	80.30	3.33	3.50	6.83	74.67	3.10	3.32	6.42
26	135111	90.10	12.17	.50	12.67	83.78	11.32	.47	11.79
27	122421	102.00	12.49	7.20	19.69	94.07	11.52	6.84	18.36
30	216400	78.50	16.99	2.30	19.29	71.79	15.54	2.18	17.72
31	51327	93.20	4.78	.30	5.08	85.48	4.39	.29	4.67
32	84105	90.00	7.57	1.30	8.87	81.27	6.84	1.23	8.07
33	967094	100.00	96.71	42.90	139.61	92.81	89.76	40.75	130.51
34	96955	100.00	9.70	9.00	18.70	93.38	9.05	8.55	17.60
35	175445	100.00	18.54	6.90	25.44	93.38	17.38	6.55	23.94
36	46516	85.70	4.99	.60	5.59	79.80	4.71	.57	5.28
37	80369	89.70	8.01	1.00	9.01	83.39	7.50	.95	8.45
38	49446	83.30	4.12	1.00	5.12	77.52	3.83	.95	4.78
39	28083	80.00	2.45	0.00	2.45	73.37	2.26	0.00	2.26
40	105126	100.00	12.21	0.00	12.21	92.22	11.39	0.00	11.39
41	29099	100.00	2.91	.40	3.31	93.38	2.72	.38	3.10
42	19411	100.00	1.94	0.00	1.94	93.38	1.81	0.00	1.81
43	72104	92.00	7.63	1.30	8.93	85.78	7.19	1.23	8.42
44	24139	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	28918	85.00	2.76	0.00	2.76	72.20	2.39	0.00	2.39
46	59524	85.00	5.06	0.00	5.06	76.54	4.56	0.00	4.56
47	72997	94.00	6.86	0.00	6.86	87.68	6.40	0.00	6.40
48	140225	90.00	17.59	4.30	21.89	83.88	16.59	4.08	20.67
49	287772	163.00	57.31	4.50	61.81	153.23	54.50	4.27	58.77
50	194746	87.00	18.34	1.20	19.54	81.03	17.18	1.14	18.32
TOTALS (S.U. 1-50.SEWERED POP. ONLY)									
	4836457		507	108	615		472	102	575

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28.29. AND 30

APPENDIX TABLE A8: BASE CASE 2 WASTEWATER FLOW PROJECTIONS FOR 1990

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	12817	85.00	1.09	0.00	1.09	76.54	.98	0.00	.98
2	16562	90.00	1.49	0.00	1.49	82.58	1.37	0.00	1.37
3	9473	100.00	.95	0.00	.95	91.06	.86	0.00	.86
4	17819	85.00	1.51	0.00	1.51	78.55	1.40	0.00	1.40
5	56336	85.00	4.79	0.00	4.79	78.44	4.42	0.00	4.42
6	33691	122.00	4.11	0.00	4.11	114.20	3.85	0.00	3.85
7	33238	80.00	2.66	0.00	2.66	71.62	2.38	0.00	2.38
8	68432	90.00	6.16	0.00	6.16	79.11	5.41	0.00	5.41
9	67308	100.00	6.73	0.00	6.73	86.84	5.84	0.00	5.84
10	27071	100.00	2.71	0.00	2.71	89.80	2.43	0.00	2.43
11	55230	100.00	5.52	.30	5.82	92.91	5.13	.29	5.42
12	88851	100.00	8.89	.50	9.39	91.32	8.11	.47	8.59
13	23936	85.00	2.03	.50	2.53	72.10	1.73	.47	2.20
14	80605	100.00	10.06	3.50	13.56	90.05	9.26	3.32	12.58
15	26133	85.00	2.22	0.00	2.22	69.34	1.81	0.00	1.81
16	43511	80.00	3.48	.10	3.58	70.94	3.09	.09	3.18
17	43664	85.00	3.71	1.16	4.87	75.74	3.31	1.10	4.41
18	403064	103.00	41.52	0.00	41.52	94.21	37.97	0.00	37.97
19	4121	100.00	.41	0.00	.41	91.73	.38	0.00	.38
20	16593	100.00	1.66	0.00	1.66	89.07	1.48	0.00	1.48
21	27431	100.00	2.74	0.00	2.74	89.61	2.46	0.00	2.46
22	66541	100.00	6.65	.50	7.15	92.53	6.16	.47	6.63
23	45350	100.00	4.53	1.90	6.43	93.38	4.24	1.80	6.04
24	531064	113.00	60.01	11.30	71.31	105.73	56.15	10.73	66.89
25	39955	80.30	3.21	3.50	6.71	74.67	2.98	3.32	6.31
26	130884	90.10	11.79	.50	12.29	83.98	10.99	.47	11.47
27	126238	102.00	12.88	7.20	20.08	93.68	11.83	6.84	18.67
30	206334	78.50	16.20	2.30	18.50	72.42	14.94	2.18	17.13
31	59204	93.20	5.52	.30	5.82	83.79	4.96	.29	5.25
32	86874	90.00	7.82	1.30	9.12	80.90	7.03	1.23	8.26
33	940332	100.00	94.03	43.90	137.93	93.20	87.64	41.70	129.34
34	93158	100.00	9.32	9.00	18.32	93.38	8.70	8.55	17.25
35	171388	100.00	18.14	6.90	25.04	93.38	17.01	6.55	23.56
36	51749	85.70	5.43	.60	6.03	78.83	5.08	.57	5.65
37	80586	89.70	8.03	1.00	9.03	83.36	7.52	.95	8.47
38	47864	83.30	3.99	1.00	4.99	77.52	3.71	.95	4.66
39	26885	80.00	2.35	0.00	2.35	73.96	2.19	0.00	2.19
40	100983	100.00	11.80	0.00	11.80	92.75	11.07	0.00	11.07
41	27999	100.00	2.80	.40	3.20	93.38	2.61	.38	2.99
42	18716	100.00	1.87	0.00	1.87	93.38	1.75	0.00	1.75
43	69221	92.00	7.37	1.30	8.67	85.78	6.94	1.23	8.17
44	27811	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	27455	85.00	2.63	0.00	2.63	72.58	2.29	0.00	2.29
46	59340	85.00	5.04	0.00	5.04	76.57	4.54	0.00	4.54
47	70231	94.00	6.60	0.00	6.60	87.68	6.16	0.00	6.16
48	134599	90.00	17.42	4.20	21.62	83.64	16.38	3.99	20.37
49	284228	163.00	56.73	4.30	61.03	153.23	53.95	4.08	58.04
50	188130	87.00	17.77	1.20	18.97	81.03	16.65	1.14	17.79
TOTALS (S.U. 1-50, SEWERED POP. ONLY)									
	4922652		514	109	623		477	103	580

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28, 29, AND 30

APPENDIX TABLE A9: BASE CASE 2 WASTEWATER FLOW PROJECTIONS FOR 1995

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	12505	85.00	1.06	0.00	1.06	76.83	.96	0.00	.96
2	17609	90.00	1.58	0.00	1.58	81.82	1.44	0.00	1.44
3	9220	100.00	.92	0.00	.92	91.38	.84	0.00	.84
4	18060	85.00	1.54	0.00	1.54	78.36	1.42	0.00	1.42
5	61384	85.00	5.22	0.00	5.22	77.33	4.75	0.00	4.75
6	33490	122.00	4.09	0.00	4.09	114.28	3.83	0.00	3.83
7	33070	80.00	2.65	0.00	2.65	71.67	2.37	0.00	2.37
8	88518	90.00	7.97	0.00	7.97	76.98	6.81	0.00	6.81
9	66972	100.00	6.70	0.00	6.70	86.87	5.82	0.00	5.82
10	31083	100.00	3.11	0.00	3.11	88.43	2.75	0.00	2.75
11	59104	100.00	5.91	.30	6.21	92.02	5.44	.29	5.72
12	91488	100.00	9.15	.50	9.65	90.97	8.32	.47	8.80
13	23530	85.00	2.00	.60	2.60	72.22	1.70	.57	2.27
14	92106	100.00	11.21	3.60	14.81	88.70	10.17	3.42	13.59
15	39948	85.00	3.40	0.00	3.40	67.84	2.71	0.00	2.71
16	43011	80.00	3.44	.11	3.55	71.06	3.06	.10	3.16
17	43395	85.00	3.69	1.23	4.92	75.81	3.29	1.17	4.46
18	401442	103.00	41.35	0.00	41.35	94.26	37.84	0.00	37.84
19	4009	100.00	.40	0.00	.40	92.08	.37	0.00	.37
20	19106	100.00	1.91	0.00	1.91	87.77	1.68	0.00	1.68
21	28598	100.00	2.86	0.00	2.86	89.19	2.55	0.00	2.55
22	67593	100.00	6.76	.52	7.28	92.32	6.24	.49	6.73
23	47190	100.00	4.72	1.95	6.67	93.38	4.41	1.85	6.26
24	538018	113.00	60.80	11.30	72.10	105.73	56.89	10.73	67.62
25	40344	80.30	3.24	3.50	6.74	74.67	3.01	3.32	6.34
26	128256	90.10	11.56	.50	12.06	83.98	10.77	.47	11.25
27	123519	102.00	12.60	7.20	19.80	93.95	11.61	6.84	18.45
30	201265	78.50	15.80	2.30	18.10	72.77	14.65	2.18	16.83
31	59145	93.20	5.51	.30	5.81	83.80	4.96	.29	5.24
32	84545	90.00	7.61	1.40	9.01	81.21	6.87	1.33	8.20
33	934448	100.00	93.44	45.00	138.44	93.28	87.17	42.75	129.92
34	91488	100.00	9.15	9.00	18.15	93.38	8.54	8.55	17.09
35	170886	100.00	18.09	6.90	24.99	93.38	16.96	6.55	23.51
36	53418	85.70	5.58	.60	6.18	78.42	5.19	.57	5.76
37	79533	89.70	7.93	1.00	8.93	83.54	7.44	.95	8.39
38	47312	83.30	3.94	1.00	4.94	77.52	3.67	.95	4.62
39	26281	80.00	2.30	0.00	2.30	74.27	2.15	0.00	2.15
40	106233	100.00	12.32	0.00	12.32	92.08	11.48	0.00	11.48
41	33194	100.00	3.32	.40	3.72	92.15	3.06	.38	3.44
42	18849	100.00	1.88	0.00	1.88	93.38	1.76	0.00	1.76
43	68057	92.00	7.76	1.30	9.06	85.78	7.34	1.23	8.57
44	27202	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	26680	85.00	2.57	0.00	2.57	72.80	2.24	0.00	2.24
46	57763	85.00	4.91	0.00	4.91	76.89	4.44	0.00	4.44
47	70696	94.00	6.65	0.00	6.65	87.68	6.20	0.00	6.20
48	131940	90.00	17.12	4.20	21.32	83.69	16.12	3.99	20.11
49	290743	163.00	57.79	4.20	61.99	153.23	54.95	3.99	58.94
50	184799	87.00	17.48	1.20	18.68	81.03	16.38	1.14	17.52
TOTALS (S.U. 1-50.SEWERED POP. ONLY)									
	4980646		521	110	631		483	105	587

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A 10: BASE CASE 2 WASTEWATER FLOW PROJECTIONS FOR 2000

		NORMAL FLOWS				WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	12314	85.00	1.05	0.00	1.05	77.02	.95	0.00	.95
2	17659	90.00	1.59	0.00	1.59	81.78	1.44	0.00	1.44
3	9065	100.00	.91	0.00	.91	91.59	.83	0.00	.83
4	17927	85.00	1.52	0.00	1.52	78.46	1.41	0.00	1.41
5	60858	85.00	5.17	0.00	5.17	77.44	4.71	0.00	4.71
6	33170	122.00	4.05	0.00	4.05	114.28	3.79	0.00	3.79
7	32533	80.00	2.60	0.00	2.60	71.86	2.34	0.00	2.34
8	86630	90.00	7.80	0.00	7.80	77.14	6.68	0.00	6.68
9	67460	100.00	6.75	0.00	6.75	86.82	5.86	0.00	5.86
10	34985	100.00	3.50	0.00	3.50	87.41	3.06	0.00	3.06
11	63002	100.00	6.30	.30	6.60	91.22	5.75	.29	6.03
12	91224	100.00	9.12	.50	9.62	91.01	8.30	.47	8.78
13	23081	85.00	1.96	.60	2.56	72.36	1.67	.57	2.24
14	93499	100.00	11.35	3.70	15.05	88.56	10.28	3.51	13.80
15	43053	85.00	3.66	0.00	3.66	67.63	2.91	0.00	2.91
16	42957	80.00	3.44	.11	3.55	71.07	3.05	.10	3.16
17	42796	85.00	3.64	1.27	4.91	75.96	3.25	1.21	4.46
18	395340	103.00	40.72	0.00	40.72	94.45	37.34	0.00	37.34
19	3939	100.00	.39	0.00	.39	92.31	.36	0.00	.36
20	19079	100.00	1.91	0.00	1.91	87.79	1.67	0.00	1.67
21	28893	100.00	2.89	0.00	2.89	89.09	2.57	0.00	2.57
22	66688	100.00	6.67	.57	7.24	92.50	6.17	.54	6.71
23	47438	100.00	4.74	2.00	6.74	93.38	4.43	1.90	6.33
24	546542	113.00	61.76	11.30	73.06	105.73	57.79	10.73	68.52
25	41684	80.30	3.35	3.50	6.85	74.67	3.11	3.32	6.44
26	126786	90.10	11.42	.50	11.92	83.98	10.65	.47	11.12
27	122148	102.00	12.46	7.20	19.66	94.10	11.49	6.84	18.33
30	198143	78.50	15.55	2.30	17.85	72.96	14.46	2.18	16.64
31	58130	93.20	5.42	.30	5.72	84.00	4.88	.29	5.17
32	83121	90.00	7.48	1.40	8.88	81.41	6.77	1.33	8.10
33	930769	100.00	93.08	46.00	139.08	93.34	86.88	43.70	130.58
34	90738	100.00	9.07	9.00	18.07	93.38	8.47	8.55	17.02
35	173454	100.00	18.35	6.90	25.25	93.38	17.20	6.55	23.75
36	54505	85.70	5.67	.60	6.27	78.17	5.26	.57	5.83
37	79377	89.70	7.92	1.00	8.92	83.57	7.43	.95	8.38
38	47272	83.30	3.94	1.00	4.94	77.52	3.66	.95	4.61
39	25907	80.00	2.27	0.00	2.27	74.38	2.13	0.00	2.13
40	116013	100.00	13.30	0.00	13.30	91.00	12.26	0.00	12.26
41	41438	100.00	4.14	.40	4.54	89.58	3.71	.38	4.09
42	19339	100.00	1.93	0.00	1.93	93.38	1.81	0.00	1.81
43	67576	92.00	7.72	1.30	9.02	85.78	7.30	1.23	8.53
44	26874	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	26206	85.00	2.53	0.00	2.53	72.94	2.21	0.00	2.21
46	56788	85.00	4.83	0.00	4.83	77.10	4.38	0.00	4.38
47	72524	94.00	6.82	0.00	6.82	87.68	6.36	0.00	6.36
48	130569	90.00	16.97	4.00	20.97	83.72	15.98	3.80	19.78
49	299817	163.00	59.27	4.00	63.27	152.96	56.26	3.80	60.06
50	182840	87.00	17.31	1.20	18.51	81.03	16.22	1.14	17.36
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	5000150		524	111	635		485	105	591

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A 11: COMPACT GROWTH WASTEWATER FLOW PROJECTIONS FOR 198

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	10890	85.00	.93	0.00	.93	79.13	.86	0.00	.86
2	15606	90.00	1.40	0.00	1.40	83.88	1.31	0.00	1.31
3	7898	100.00	.79	0.00	.79	93.38	.74	0.00	.74
4	18127	85.00	1.54	0.00	1.54	79.13	1.43	0.00	1.43
5	53609	85.00	4.56	0.00	4.56	79.13	4.24	0.00	4.24
6	33804	122.00	4.12	0.00	4.12	114.28	3.86	0.00	3.86
7	27957	80.00	2.24	0.00	2.24	74.38	2.08	0.00	2.08
8	47456	90.00	4.27	0.00	4.27	83.88	3.98	0.00	3.98
9	36713	100.00	3.67	0.00	3.67	93.38	3.43	0.00	3.43
10	20193	100.00	2.02	0.00	2.02	93.38	1.89	0.00	1.89
11	53509	100.00	5.35	.30	5.65	93.38	5.00	.29	5.28
12	78738	100.00	7.87	.50	8.37	93.38	7.35	.47	7.83
13	11534	85.00	.98	.40	1.38	79.13	.91	.38	1.29
14	60667	100.00	8.07	3.20	11.27	93.38	7.67	3.04	10.71
15	8275	85.00	.70	0.00	.70	79.13	.65	0.00	.65
16	32866	80.00	2.63	.08	2.71	74.38	2.44	.08	2.52
17	33179	85.00	2.82	.95	3.77	79.13	2.63	.90	3.53
18	342616	103.00	35.29	0.00	35.29	96.23	32.97	0.00	32.97
19	3795	100.00	.38	0.00	.38	93.38	.35	0.00	.35
20	10542	100.00	1.05	0.00	1.05	93.38	.98	0.00	.98
21	18354	100.00	1.84	0.00	1.84	93.38	1.71	0.00	1.71
22	62189	100.00	6.22	.43	6.65	93.38	5.81	.41	6.22
23	49694	100.00	4.97	1.81	6.78	93.38	4.64	1.72	6.36
24	573113	113.00	64.76	11.30	76.06	105.73	60.60	10.73	71.33
25	44737	80.30	3.59	3.50	7.09	74.67	3.34	3.32	6.67
26	133002	90.10	11.98	.50	12.48	83.98	11.17	.47	11.64
27	114603	102.00	11.69	7.20	18.89	95.28	10.92	6.84	17.76
30	199244	78.50	15.64	2.30	17.94	72.96	14.54	2.18	16.72
31	45107	93.20	4.20	.30	4.50	86.92	3.92	.29	4.21
32	74846	90.00	6.74	1.30	8.04	83.88	6.28	1.23	7.51
33	907955	100.00	90.80	41.80	132.60	93.38	84.79	39.71	124.50
34	100905	100.00	10.09	7.50	17.59	93.38	9.42	7.12	16.55
35	173340	100.00	18.33	6.90	25.23	93.38	17.19	6.55	23.74
36	50872	85.70	5.36	.60	5.96	79.80	5.06	.57	5.63
37	74740	89.70	7.50	1.00	8.50	83.60	7.05	.95	8.00
38	51549	83.30	4.29	1.00	5.29	77.52	4.00	.95	4.95
39	25557	80.00	2.24	0.00	2.24	74.38	2.10	0.00	2.10
40	88409	100.00	10.54	0.00	10.54	93.38	9.96	0.00	9.96
41	38662	100.00	3.87	.40	4.27	93.38	3.61	.38	3.99
42	23425	100.00	2.34	0.00	2.34	93.38	2.19	0.00	2.19
43	75995	92.00	7.99	1.30	9.29	85.78	7.52	1.23	8.75
44	27598	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	14308	85.00	1.52	0.00	1.52	79.13	1.43	0.00	1.43
46	46807	85.00	3.98	0.00	3.98	79.13	3.70	0.00	3.70
47	72599	94.00	6.82	0.00	6.82	87.68	6.37	0.00	6.37
48	147940	90.00	18.60	4.40	23.00	83.88	17.53	4.18	21.71
49	296607	163.00	58.75	4.70	63.45	153.23	55.85	4.46	60.32
50	202026	87.00	18.98	1.20	20.18	81.03	17.77	1.14	18.91
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	4692824		494	105	599		463	100	563

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A12 : COMPACT GROWTH WASTE-WATER FLOW PROJECTIONS FOR 1985

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	10394	85.00	.88	0.00	.88	79.13	.82	0.00	.82
2	18365	90.00	1.65	0.00	1.65	81.76	1.50	0.00	1.50
3	7990	100.00	.80	0.00	.80	93.22	.74	0.00	.74
4	17975	85.00	1.53	0.00	1.53	79.13	1.42	0.00	1.42
5	54051	85.00	4.59	0.00	4.59	79.02	4.27	0.00	4.27
6	34612	122.00	4.22	0.00	4.22	113.95	3.94	0.00	3.94
7	27500	80.00	2.20	0.00	2.20	74.38	2.05	0.00	2.05
8	51244	90.00	4.61	0.00	4.61	82.84	4.24	0.00	4.24
9	44975	100.00	4.50	0.00	4.50	90.78	4.08	0.00	4.08
10	22984	100.00	2.30	0.00	2.30	91.67	2.11	0.00	2.11
11	54616	100.00	5.46	.30	5.76	93.10	5.08	.29	5.37
12	87314	100.00	8.73	.50	9.23	91.99	8.03	.47	8.51
13	14805	85.00	1.26	.50	1.76	76.01	1.13	.47	1.60
14	65508	100.00	8.55	3.40	11.95	92.34	8.05	3.23	11.28
15	10024	85.00	.85	0.00	.85	76.67	.77	0.00	.77
16	33559	80.00	2.68	.09	2.77	74.09	2.49	.09	2.57
17	33647	85.00	2.86	1.10	3.96	78.94	2.66	1.04	3.70
18	373750	103.00	38.50	0.00	38.50	95.06	35.53	0.00	35.53
19	3832	100.00	.38	0.00	.38	93.25	.36	0.00	.36
20	11022	100.00	1.10	0.00	1.10	92.77	1.02	0.00	1.02
21	17264	100.00	1.73	0.00	1.73	93.38	1.61	0.00	1.61
22	63194	100.00	6.32	.48	6.80	93.16	5.89	.46	6.34
23	48412	100.00	4.84	1.86	6.70	93.38	4.52	1.77	6.29
24	581458	113.00	65.70	11.30	77.00	105.53	61.36	10.73	72.10
25	44705	80.30	3.59	3.50	7.09	74.67	3.34	3.32	6.66
26	136856	90.10	12.33	.50	12.83	83.58	11.44	.47	11.91
27	120181	102.00	12.26	7.20	19.46	94.63	11.37	6.84	18.21
30	214424	78.50	16.83	2.30	19.13	71.96	15.43	2.18	17.61
31	42372	93.20	3.95	.30	4.25	86.92	3.68	.29	3.97
32	75564	90.00	6.80	1.30	8.10	83.75	6.33	1.23	7.56
33	945448	100.00	94.54	42.90	137.44	92.82	87.76	40.75	128.51
34	95938	100.00	9.59	9.00	18.59	93.38	8.96	8.55	17.51
35	172587	100.00	18.26	6.90	25.16	93.38	17.12	6.55	23.67
36	52173	85.70	5.47	.60	6.07	79.45	5.14	.57	5.71
37	73560	89.70	7.40	1.00	8.40	83.60	6.95	.95	7.90
38	50683	83.30	4.22	1.00	5.22	77.52	3.93	.95	4.88
39	27300	80.00	2.38	0.00	2.38	73.48	2.21	0.00	2.21
40	94014	100.00	11.10	0.00	11.10	92.54	10.40	0.00	10.40
41	39822	100.00	3.98	.40	4.38	92.97	3.70	.38	4.08
42	23874	100.00	2.39	0.00	2.39	93.12	2.22	0.00	2.22
43	72232	92.00	7.65	1.30	8.95	85.78	7.20	1.23	8.43
44	26944	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	25515	85.00	2.47	0.00	2.47	72.92	2.16	0.00	2.16
46	60432	85.00	5.14	0.00	5.14	75.94	4.59	0.00	4.59
47	73496	94.00	6.91	0.00	6.91	87.51	6.43	0.00	6.43
48	140386	90.00	17.86	4.30	22.16	83.88	16.84	4.08	20.92
49	293717	163.00	58.28	4.50	62.78	153.23	55.41	4.27	59.68
50	194342	87.00	18.31	1.20	19.51	81.03	17.15	1.14	18.29
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	4834456		508	108	616		473	102	576

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A13: COMPACT GROWTH WASTEWATER FLOW PROJECTIONS FOR 199

		NORMAL FLOWS				WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	10854	85.00	.92	0.00	.92	79.13	.86	0.00	.86
2	18243	90.00	1.64	0.00	1.64	81.84	1.49	0.00	1.49
3	7917	100.00	.79	0.00	.79	93.35	.74	0.00	.74
4	17494	85.00	1.49	0.00	1.49	79.13	1.38	0.00	1.38
5	53601	85.00	4.56	0.00	4.56	79.13	4.24	0.00	4.24
6	35490	122.00	4.33	0.00	4.33	113.61	4.03	0.00	4.03
7	26726	80.00	2.14	0.00	2.14	74.38	1.99	0.00	1.99
8	54123	90.00	4.87	0.00	4.87	82.14	4.45	0.00	4.45
9	58124	100.00	5.81	0.00	5.81	88.17	5.12	0.00	5.12
10	27889	100.00	2.79	0.00	2.79	89.48	2.50	0.00	2.50
11	57590	100.00	5.76	.30	6.06	92.38	5.32	.29	5.61
12	90069	100.00	9.01	.50	9.51	91.60	8.25	.47	8.73
13	17938	85.00	1.52	.50	2.02	74.08	1.33	.47	1.80
14	71124	100.00	9.11	3.50	12.61	91.30	8.49	3.32	11.82
15	10933	85.00	.93	0.00	.93	75.69	.83	0.00	.83
16	35421	80.00	2.83	.10	2.93	73.36	2.60	.09	2.69
17	35733	85.00	3.04	1.16	4.20	78.12	2.79	1.10	3.89
18	380878	103.00	39.23	0.00	39.23	94.81	36.11	0.00	36.11
19	3827	100.00	.38	0.00	.38	93.27	.36	0.00	.36
20	14410	100.00	1.44	0.00	1.44	89.59	1.29	0.00	1.29
21	24154	100.00	2.42	0.00	2.42	89.99	2.17	0.00	2.17
22	64892	100.00	6.49	.50	6.99	92.80	6.02	.47	6.50
23	47807	100.00	4.78	1.90	6.68	93.38	4.46	1.80	6.27
24	587377	113.00	66.37	11.30	77.67	105.39	61.90	10.73	72.64
25	44528	80.30	3.58	3.50	7.08	74.67	3.32	3.32	6.65
26	131855	90.10	11.88	.50	12.38	83.98	11.07	.47	11.55
27	124217	102.00	12.67	7.20	19.87	94.19	11.70	6.84	18.54
30	211214	78.50	16.58	2.30	18.88	72.16	15.24	2.18	17.43
31	51087	93.20	4.76	.30	5.06	85.27	4.36	.29	4.64
32	87971	90.00	7.92	1.30	9.22	81.77	7.19	1.23	8.43
33	944191	100.00	94.42	43.90	138.32	92.84	87.66	41.70	129.37
34	93571	100.00	9.36	9.00	18.36	93.38	8.74	8.55	17.29
35	182054	100.00	19.21	6.90	26.11	92.71	17.88	6.55	24.43
36	51741	85.70	5.43	.60	6.03	79.56	5.12	.57	5.69
37	72821	89.70	7.33	1.00	8.33	83.60	6.89	.95	7.84
38	50200	83.30	4.18	1.00	5.18	77.52	3.89	.95	4.84
39	27311	80.00	2.38	0.00	2.38	73.48	2.21	0.00	2.21
40	108927	100.00	12.59	0.00	12.59	90.72	11.58	0.00	11.58
41	39590	100.00	3.96	.40	4.36	93.05	3.68	.38	4.06
42	23913	100.00	2.39	0.00	2.39	93.10	2.23	0.00	2.23
43	70549	92.00	7.49	1.30	8.79	85.78	7.05	1.23	8.29
44	31572	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	26613	85.00	2.56	0.00	2.56	72.59	2.23	0.00	2.23
46	57616	85.00	4.90	0.00	4.90	76.48	4.41	0.00	4.41
47	88893	94.00	8.36	0.00	8.36	85.09	7.56	0.00	7.56
48	134863	90.00	17.78	4.20	21.98	83.55	16.71	3.99	20.70
49	294521	163.00	58.41	4.30	62.71	153.23	55.53	4.08	59.62
50	187734	87.00	17.73	1.20	18.93	81.03	16.61	1.14	17.75
TOTALS (S.U. 1-50, SEWERED POP. ONLY)									
	4937456		519	109	627		482	103	585

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28, 29, AND 30

APPENDIX TABLE A 1A: COMPACT GROWTH WASTEWATER FLOW PROJECTIONS FOR 1995

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	11195	85.00	.95	0.00	.95	78.75	.88	0.00	.88
2	18354	90.00	1.65	0.00	1.65	81.77	1.50	0.00	1.50
3	7864	100.00	.79	0.00	.79	93.38	.73	0.00	.73
4	17518	85.00	1.49	0.00	1.49	79.13	1.39	0.00	1.39
5	53539	85.00	4.55	0.00	4.55	79.13	4.24	0.00	4.24
6	35225	122.00	4.30	0.00	4.30	113.71	4.01	0.00	4.01
7	28141	80.00	2.25	0.00	2.25	74.29	2.09	0.00	2.09
8	59826	90.00	5.38	0.00	5.38	80.96	4.84	0.00	4.84
9	66250	100.00	6.63	0.00	6.63	87.07	5.77	0.00	5.77
10	34349	100.00	3.43	0.00	3.43	87.55	3.01	0.00	3.01
11	60709	100.00	6.07	.30	6.37	91.71	5.57	.29	5.85
12	91241	100.00	9.12	.50	9.62	91.45	8.34	.47	8.82
13	19410	85.00	1.65	.60	2.25	73.39	1.42	.57	1.99
14	81757	100.00	10.18	3.60	13.78	89.73	9.34	3.42	12.76
15	12769	85.00	1.09	0.00	1.09	74.15	.95	0.00	.95
16	36554	80.00	2.92	.11	3.03	72.96	2.67	.10	2.77
17	36870	85.00	3.13	1.23	4.36	77.72	2.87	1.17	4.03
18	379730	103.00	39.11	0.00	39.11	94.85	36.02	0.00	36.02
19	3896	100.00	.39	0.00	.39	93.02	.36	0.00	.36
20	15041	100.00	1.50	0.00	1.50	89.15	1.34	0.00	1.34
21	25473	100.00	2.55	0.00	2.55	89.43	2.28	0.00	2.28
22	64485	100.00	6.45	.52	6.97	92.88	5.99	.49	6.48
23	47615	100.00	4.76	1.95	6.71	93.38	4.45	1.85	6.30
24	587984	113.00	66.44	11.30	77.74	105.38	61.96	10.73	72.69
25	44252	80.30	3.55	3.50	7.05	74.67	3.30	3.32	6.63
26	129481	90.10	11.67	.50	12.17	83.98	10.87	.47	11.35
27	124625	102.00	12.71	7.20	19.91	94.15	11.73	6.84	18.57
30	205971	78.50	16.17	2.30	18.47	72.50	14.93	2.18	17.12
31	52754	93.20	4.92	.30	5.22	84.87	4.48	.29	4.76
32	89507	90.00	8.06	1.40	9.46	81.57	7.30	1.33	8.63
33	953130	100.00	95.31	45.00	140.31	92.71	88.37	42.75	131.12
34	92665	100.00	9.27	9.00	18.27	93.38	8.65	8.55	17.20
35	188585	100.00	19.86	6.90	26.76	92.24	18.40	6.55	24.95
36	57072	85.70	5.89	.60	6.49	78.26	5.47	.57	6.04
37	74080	89.70	7.44	1.00	8.44	83.60	6.99	.95	7.94
38	49940	83.30	4.16	1.00	5.16	77.52	3.87	.95	4.82
39	26683	80.00	2.33	0.00	2.33	73.79	2.17	0.00	2.17
40	108185	100.00	12.52	0.00	12.52	90.80	11.52	0.00	11.52
41	39783	100.00	3.98	.40	4.38	92.99	3.70	.38	4.08
42	24063	100.00	2.41	0.00	2.41	93.01	2.24	0.00	2.24
43	69118	92.00	7.86	1.30	9.16	85.78	7.43	1.23	8.66
44	32110	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	26025	85.00	2.51	0.00	2.51	72.76	2.19	0.00	2.19
46	56415	85.00	4.80	0.00	4.80	76.72	4.33	0.00	4.33
47	88721	94.00	8.34	0.00	8.34	85.11	7.55	0.00	7.55
48	132006	90.00	17.57	4.20	21.77	83.50	16.50	3.99	20.49
49	292535	163.00	58.08	4.20	62.28	153.23	55.23	3.99	59.22
50	184409	87.00	17.44	1.20	18.64	81.03	16.34	1.14	17.48
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	4983493		524	110	634		486	105	590

NOTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

APPENDIX TABLE A 15: COMPACT GROWTH WASTEWATER FLOW PROJECTIONS FOR 200

	NORMAL FLOWS					WITH CONSERVATION			
S.U.	POP.SERVED	GPCD	DF	IF	ADWF	GPCD	DF	IF	ADWF
1	12078	85.00	1.03	0.00	1.03	77.74	.94	0.00	.94
2	18588	90.00	1.67	0.00	1.67	81.61	1.52	0.00	1.52
3	7996	100.00	.80	0.00	.80	93.21	.75	0.00	.75
4	17886	85.00	1.52	0.00	1.52	79.13	1.42	0.00	1.42
5	54068	85.00	4.60	0.00	4.60	79.01	4.27	0.00	4.27
6	35262	122.00	4.30	0.00	4.30	113.70	4.01	0.00	4.01
7	29582	80.00	2.37	0.00	2.37	73.61	2.18	0.00	2.18
8	62831	90.00	5.65	0.00	5.65	80.42	5.05	0.00	5.05
9	69758	100.00	6.98	0.00	6.98	86.68	6.05	0.00	6.05
10	39709	100.00	3.97	0.00	3.97	86.43	3.43	0.00	3.43
11	63242	100.00	6.32	.30	6.62	91.21	5.77	.29	6.05
12	92072	100.00	9.21	.50	9.71	91.34	8.41	.47	8.88
13	19948	85.00	1.70	.60	2.30	73.16	1.46	.57	2.03
14	86078	100.00	10.61	3.70	14.31	89.21	9.68	3.51	13.19
15	14451	85.00	1.23	0.00	1.23	73.09	1.06	0.00	1.06
16	37492	80.00	3.00	.11	3.11	72.64	2.72	.10	2.83
17	37731	85.00	3.21	1.27	4.48	77.43	2.92	1.21	4.13
18	378458	103.00	38.98	0.00	38.98	94.89	35.91	0.00	35.91
19	3928	100.00	.39	0.00	.39	92.91	.36	0.00	.36
20	15277	100.00	1.53	0.00	1.53	89.00	1.36	0.00	1.36
21	26010	100.00	2.60	0.00	2.60	89.22	2.32	0.00	2.32
22	64122	100.00	6.41	.57	6.98	92.96	5.96	.54	6.50
23	47800	100.00	4.78	2.00	6.78	93.38	4.46	1.90	6.36
24	592990	113.00	67.01	11.30	78.31	105.26	62.42	10.73	73.15
25	44297	80.30	3.56	3.50	7.06	74.67	3.31	3.32	6.63
26	127968	90.10	11.53	.50	12.03	83.98	10.75	.47	11.22
27	124126	102.00	12.66	7.20	19.86	94.20	11.69	6.84	18.53
30	202739	78.50	15.92	2.30	18.22	72.72	14.74	2.18	16.93
31	53091	93.20	4.95	.30	5.25	84.80	4.50	.29	4.79
32	88691	90.00	7.98	1.40	9.38	81.68	7.24	1.33	8.57
33	951539	100.00	95.15	46.00	141.15	92.74	88.24	43.70	131.94
34	92184	100.00	9.22	9.00	18.22	93.38	8.61	8.55	17.16
35	193059	100.00	20.31	6.90	27.21	91.94	18.75	6.55	25.30
36	58180	85.70	5.99	.60	6.59	78.02	5.54	.57	6.11
37	73717	89.70	7.41	1.00	8.41	83.60	6.96	.95	7.91
38	49873	83.30	4.15	1.00	5.15	77.52	3.87	.95	4.82
39	26294	80.00	2.30	0.00	2.30	73.99	2.15	0.00	2.15
40	108261	100.00	12.53	0.00	12.53	90.79	11.53	0.00	11.53
41	40266	100.00	4.03	.40	4.43	92.82	3.74	.38	4.12
42	24370	100.00	2.44	0.00	2.44	92.84	2.26	0.00	2.26
43	68263	92.00	7.78	1.30	9.08	85.78	7.36	1.23	8.59
44	32360	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	25653	85.00	2.48	0.00	2.48	72.87	2.17	0.00	2.17
46	55629	85.00	4.73	0.00	4.73	76.89	4.28	0.00	4.28
47	89316	94.00	8.40	0.00	8.40	85.04	7.60	0.00	7.60
48	130306	90.00	17.44	4.00	21.44	83.47	16.38	3.80	20.18
49	291680	163.00	57.94	4.00	61.94	153.23	55.10	3.80	58.90
50	182453	87.00	17.27	1.20	18.47	81.03	16.19	1.14	17.33
TOTALS (S.U. 1-50,SEWERED POP. ONLY)									
	5004112		526	111	637		487	105	593

NCTE THAT S.U. 30 COMPRISES PREVIOUSLY DEFINED S.U. 28,29, AND 30

WQ/Tech Memo 28/November 1977
H. J. Naftzger

WATER QUALITY MANAGEMENT PLAN

RECOMMENDATIONS ON MAINTENANCE OF OUTFLOW RATES FROM THE SACRAMENTO - SAN JOAQUIN DELTA

TECHNICAL MEMORANDUM NO. 28

NOVEMBER 1977

Summary

Salinity levels in the delta and San Francisco Bay are closely linked to outflow rates from the delta. Certain minimum outflows are needed to protect a variety of beneficial water uses in and around the delta that depend on a supply of essentially fresh water. Large surges of outflow in winter and spring cause large variations in salinity throughout most of the bay system. This imparts an estuarine character to the system and is reflected in the overall diversity and general makeup of aquatic species.

Increasing upstream control and massive exports of water to other parts of the State have reduced the amount of water flowing out through the delta. Under current planning, this trend will continue. Thus maintenance of low salinities and typical winter surge flows must compete for water with uses throughout much of the State.

The State Water Resources Control Board has had in force for the last ten years regulations controlling salinity levels in the delta, hence controlling minimum delta outflow rates. Under emergency drought regulations this year delta salinity levels were permitted to rise above normally acceptable maxima, to conserve water. The State Board is working now to develop a new water quality plan for the delta which will replace existing regulations. ABAG supports this work of the Board. It is assumed that the emergency relaxed standards of the present year will not stand as a precedent for planning for future critical water years.

ABAG and others have urged, and the State Board is considering, incorporation in the regulations of provision for maintaining surge outflows to protect the estuarine character of the bay system. The State Board's position is that not enough is known at this time to take specific action; the Board is supporting research to enlarge knowledge in this area. ABAG supports this research, but in addition advances a specific but tentative proposal for maintenance of surge

flows, in order to focus attention on the need to resolve this matter.

Reduction of delta outflow to the bay can possibly have other impacts on the biota of the bay. In each of these cases, as well as for the question of surge outflows, we have less information available now than we need for intelligent decision-making. A few years' time appears to be available before hard, final decisions must be made on allocation of water for protection of beneficial uses in the bay. That time must be used effectively to perform the research necessary for a sound base for these decisions.

Introduction

A number of beneficial uses of water in the Sacramento - San Joaquin Delta area and also San Francisco Bay impose requirements on salinity of the water, usually upper limits. Regulations on salinity have been established to protect agricultural, municipal, industrial and wildlife habitat uses within the delta or drawing water from the delta. In general, rates of outflow from the delta determine salinity levels in the delta and adjacent bay. Thus, maintaining sufficiently low salinities is a matter of maintaining a sufficiently high outflow rate.

The biota of the bay-delta system is influenced in a more complex way by salinity levels and tidal and river currents. Different species are acclimated to live in water of different salinity ranges. Essential nutrients are carried in from various sources, moved and mixed by the currents which also aid in mixing fresh and salt water and in moving certain life forms from one part of the bay-delta system to another at critical times. Salinity levels and the salinity structure throughout most of the bay are strongly affected by large surges in delta outflow; current patterns in turn are affected significantly by changes in the salinity structure. Delta outflow at all stages, but especially at flood, has a very substantial influence on the kind and distribution of species in the bay system.

The San Francisco Bay Estuary

The San Francisco Bay system is a large river estuary. It combines a variety of attributes, including temperature conditions, shallow water, protection, nutrient inputs and salinity variations in both time and space, which lead to high species diversity and high biological productivity. Estuaries are, in fact, among the most productive of all types of environment on earth.

The Northern reach of the bay - Golden Gate to Pittsburg - is a classical estuary. Fresh water from the delta enters year-round at the upper end in quantities varying with the season. The fresh water mixes with salt water from the ocean over a distance of several miles of the Northern reach, producing a salinity gradient or salt wedge. The position of the salt wedge moves daily several miles in and out with the tides, and is affected even more strongly by seasonal variations in delta outflow. With very large winter flood flows, the salt wedge can move out south of the San Rafael Bridge; in the

historical past, before upstream regulation provided a floor for summer flow rates, dry season low flows could move the salt wedge up into the lower delta. Thus most parts of the Northern reach are subject to substantially varying salinities on a daily and seasonal basis. This fact is reflected in the kinds, diversity and locations of species living in this portion of the bay. These physical and biological relationships have been described in detail elsewhere. (1) (2)

The Southern reach of the bay - Golden Gate to Coyote Creek near San Jose - has only relatively small tributary streams discharging fresh water into it. Nominally, it would seem then that this reach would behave much less as an estuary than as a salt-water bay. However, it has been developed by McCullough et al (3), Imberger et al (4), and others, that winter flood flows out of the delta via the Northern reach strongly affect the major portion of the Southern reach by producing a marked reduction in salinities in that section of the bay. The magnitude of this effect is roughly proportional to the flow rate out of the delta. This salinity reduction, once instituted, takes several weeks to several months to disappear. Winter flows sufficient to produce significant salinity reduction in the Southern reach have occurred in approximately 90% of years of historical record. Thus seasonally variable salinity conditions exist in the Southern reach as well as in the Northern. It is likely that this has a significant effect on the Southern reach biota.

Management of Delta Outflow

Controls and diversions of water within and upstream of the delta have a marked effect on the magnitude and timing of delta outflows. In some respects, this has been beneficial -- provision of a minimum for summer outflow rates has been mentioned earlier. A considerable part of total inflow to the delta is viewed as "surplus" by many; that is, capable of being diverted to other uses without harming established needs in bay or delta. Massive amounts of water are presently exported south out of the delta by the Central Valley Project (Federal) and the State Water Project -- 3.5 million acre-feet in 1973, or roughly enough for domestic supply for everyone living in California. Current planning calls for the export volume to double by 1990. A fraction of the delta export plus certain upstream diversions come to the Bay Area for municipal supply.

Historical flow data covering the last 56 years suggest there is ample water in an "average" year to support the proposed export levels. However, most years are not average: the largest annual delta outflow volume was approximately ten times the smallest in the period of record. Seasonal flow variations are substantial, with low natural flows in summer when highest irrigation requirements occur. Hence massive projects have been built providing detention of larger winter and spring flows, storage and release at times of greater demand. Storage volumes must be sufficient to bridge several years of low natural flow, such as the present drought. Releases must cover export needs, water supply requirements in and around the delta, plus enough additional to maintain salinities below required levels.

Concerns have been raised recently that the control systems and water allocations should allow adequately for relatively uncontrolled storm outflows from the delta. As described earlier, flood surges from the delta produce large salinity variations throughout most of the bay system and are primarily responsible for imparting an estuarine character to the Southern reach. Increasing controls and export demands will decrease the flood flow volumes reaching the bay. Of 56 years of record, in only six years were flood outflows small enough to be of questionable value in lowering salinities throughout the bay. However, using State Department of Water Resources estimates (5) of delta outflows for the same 56 years if 1990-level controls and exports had been in effect, in at least 16 of these years winter flows would have been small enough to be of doubtful value in lowering Southern reach salinities significantly.

Maintenance of Minimum Delta Outflow Rates

A variety of beneficial water uses in the delta and the bay are dependent in considerable degree on water salinity. These include the following, as described by J.B. Gilbert and Associates (2) and by the Delta Environmental Advisory Committee (6):

- Agriculture within the delta
- Agriculture adjacent to the Western delta
- Municipal and industrial supply
- Maintenance of Suisun Marsh wetlands --one of the largest marshes in the contiguous United States --as waterfowl habitat
- Striped bass spawning in the lower San Joaquin River
- Feeding ground habitat in Suisun Bay for young striped bass and other food fish

Beginning in 1967, salinity regulations for the delta and upper Suisun Bay have been in force. These regulations are set and administered by the State Water Resources Control Board. Several modifying orders have been issued since the original regulation went into effect. Maximum salinity levels are stipulated for certain points in the delta-bay system and for certain times of year (2). Sufficient delta outflow must be maintained that these maxima are not exceeded. The outflow needed to meet a given criterion will vary somewhat with wind, weather and tide conditions.

In this drought year of 1977, the State Board issued "Interim Water Quality Control Plan for 1977" in February, followed by an Emergency Regulation in June. These documents successively relaxed delta salinity requirements. These moves were necessitated by dwindling stored water supplies upstream brought on by the drought, and the need to minimize all water uses including salinity control. Salinity in water supplied for municipal and industrial purposes was allowed to exceed normally acceptable levels. The Interim Plan and the Emergency Regulation expire at the end of 1977 unless renewed by the State Board.

The State Board is presently working to develop a new water quality control plan for the delta. This plan will revise, consolidate and

replace existing regulations. It is believed that all important beneficial water uses are being considered in preparing this plan. ABAG supports this work of the State Board. It is assumed that establishment this year of emergency relaxed salinity standards will not serve as a precedent for planning for future critical water years. The Emergency Regulation this year was forced on the delta region by circumstances. Planned salinity levels should conform to normally acceptable standards in all years.

Provision for Seasonal Elevated Delta Outflow Rates

A surge of delta outflow produces a response in the salinity structure of a large part of the bay system, as mentioned earlier. Fresher water, being less dense, moves seaward in the upper part of the water mass over heavier, more saline water. This results in a salinity (and density) stratification (4). There will usually be an upstream-moving current induced in the bottom, more saline water. The stratified condition will extend over some miles of the Northern reach, with both upper and lower layers becoming more salty approaching the bay. The degree of stratification and location of the longitudinal salinity gradient are functions of the outflow rate.

With a sufficient buildup in delta outflow, salinity stratification is felt clear down into the Central Bay, opposite the Golden Gate (3) (4). When this happens (historically, such flows have occurred several times in many years and at least once in most), large lenses of less saline water are carried into the Southern reach, below the Bay Bridge. This produces a salinity stratification in the Southern reach as well, with less salty water on top. As in the Northern reach, current patterns are altered, with a counterflow current in the saltier bottom water. A longitudinal salinity gradient is also produced. The vertical stratification pattern is destroyed by vertical mixing within a few days of the influx of fresher water. The longitudinal salinity differences persist much longer, being eliminated by tidal mixing only over a period of months for the larger events.

The degree of reduction of salinity in the Southern reach and the geographical extent of the effect seem to be roughly related to the rate of delta outflow. Because vertical stratification disappears relatively quickly, the degree of stratification produced in an event seems to depend also on the recent history of the reach and on the magnitude of increase in delta outflow over a few days' time. Thus a surge of, say, 50,000 cubic feet per second (cfs) will produce a certain stratification in the Southern reach. The stratification will disappear within a few days, leaving behind reduced salinity levels which are uniform over depth and which can persist several months. A second surge of 100,000 cfs a month later will produce a new stratification and will further lower salinity values, whereas a second surge of 50,000 cfs would have a rather limited effect.

The small, isolated segment of the bay south of Dumbarton Bridge seems to behave as a typical estuary, influenced more by (and stratified by) outflow from local streams than by events in the main body of the Southern reach. A degree of interaction between the main Southern

reach and the extreme South Bay does exist, however.

In the Northern reach, typical salinity patterns have a significant effect on the distribution of species. Marine and estuarine species predominate west of Carquinez Strait; upstream of the strait, to the east, freshwater and estuarine species predominate (1). More mobile species such as fish, shrimp and crabs tend to respond to the large seasonal and annual salinity changes previously described by shifting their ranges suitably. Benthic (bottom-dwelling) creatures remain essentially in place. Because of the salinity variations encountered regularly, all species must have a tolerance for some range of salinity levels. Salinity variations in the Southern reach provide similar stimuli to species inhabiting that area.

Salinity stratifications accompanying delta outflow surges are responsible in both reaches for setting up unique circulation patterns. Opposing currents of less saline water near the surface and more saline water near the bottom are quite effective in circulating nutrients, sediments and life forms such as invertebrate larvae and juvenile fish throughout much of the bay system. The circulation during strong stratification is considerably more effective than that when stratification is absent.

Moderately elevated outflows serve other functions. Kelley (6) suggests that a delta discharge rate of 10,000 cfs in late winter/early spring may be needed to provide suitable salinity water to Suisun Marsh. The life cycle of striped bass in the bay and delta depends substantially on delta outflow patterns; reductions in bass populations in recent years have been correlated with outflow reductions. Salmon are probably similarly effected. (Cross-delta flow patterns produced by export pumping are also very significant in reduction of fish populations. The issue of a delta transfer facility --eg. Peripheral Canal -- is not dealt with in this memo.)

While there is much that is not known about the relationships of physical, chemical and biological phenomena in the bay, it is evident that surges of delta outflow, occurring typically several times a year, have a strong and lasting effect on the physical-chemical environment of most of the bay system. It can be assumed -- subject to later proof -- that because this is a natural condition for the bay, it is beneficial to the living communities of the bay. Further research must be done to verify, or disprove, this contention. Meanwhile, an entitlement to this surge effect on the part of the living communities must be protected.

Even under planned upstream management and diversion at 1990 levels, in average-to-wet years there will be ample uncommitted water to allow for several surge events in a year. It is in dry and critical years that specific provision should be made for elevated delta outflow. The following tentative proposal is therefore put forward:

- A minimum of 2 million acre-feet of water per year will be reserved for elevated delta outflow.

- 1 million acre-feet of this reservation will be released in a five day pulse at the rate of 100,000 cubic feet per second.

(The magnitude and duration of the pulse is subject to optimization.)

- o The second 1 million acre-feet will be released, immediately following the pulse, at a 10,000 cfs rate over a 50-day period.

- o These provisions represent a minimum, not a typical, allotment of water. In average-to-wet years, greater quantities of water should be available to elevated delta outflow.

The State Water Resources Control Board (7) has indicated its continuing commitment to protecting beneficial uses of the bay, including allowance for elevated delta outflows. The Board has also indicated its belief that not enough quantitative information is available now to justify adopting specific numerical standards at this time. The Board feels that foreseeable events of the next ten years or so do not place availability of water for this purpose in jeopardy. This provides some time for more specific studies into fresh water discharge requirements for the bay; the State Board is supporting studies in this area. One of the fields of research for the San Francisco Bay-Delta Research Program proposed by ABAG in the Environmental Management Plan would be delta outflow relationships and effects. However, ABAG feels that it will be very useful to have a specific proposal on water allocation put forward at this time to stimulate interest, discussion and research, and has therefore advanced the measures outlined above. The reservation of water suggested here is based on present knowledge; in all likelihood the numbers proposed will be revised as new information becomes available.

The rationale for the reservation of water suggested above is as follows: A quite substantial delta outflow rate is required for stratification and reduction of salinity to a significant degree in the Central Bay (opposite the Golden Gate) and on into the Southern reach. While total volume of water in the pulse is not too important, the pulse must be of sufficient duration to be effective. A judgment was made that the magnitude and duration suggested above would be effective.

The sustained outflow of 10,000 cfs following the pulse is intended to retard, in some degree, destratification and the process of return to higher salinities in the Central Bay and Southern reach. In addition, this somewhat elevated outflow rate can be timed to be beneficial in the striped bass life cycle and in maintaining appropriate salinities for Suisun Marsh. This timing would place the 100,000 cfs initial pulse around early April, when the presence or absence of natural outflow surges and hence the need of managed elevated outflow in a given year would be well established.

ABAG supports further research in this area, but stresses the viewpoint that a reservation of water must be made to ensure that surge outflows occur at least on an annual basis. The proposal made above is a beginning toward achieving that goal.

Other Concerns

Some other concerns have been expressed in connection with prospective reductions in delta outflow due to proposed increased exports. One of these concerns involves the probable reduction in sediment inputs to the bay. It is estimated that about 75% of the suspended sediment entering the bay comes entrained in delta outflow. The sediment is distributed to various parts of the bay, settles out, is resuspended by wave and tide action, and finally settles again or is carried out of the bay by tidal exchange. (1)

The suspended sediment imparts turbidity to the waters of the bay, thus limiting the amount of light entering the water. Light is essential to the growth of algae, the green plants of water environments. Most algae, particularly diatoms which presently dominate in the bay, are vital to aquatic biological productivity because they constitute the basic first link in the food chain. Some kinds of algae, however, can create a nuisance through toxic properties or sheer mass; some algae also are much less useful than diatoms in the food chain. It has been speculated that less sediment input to the bay would result in less turbid water, more light penetration, and more algae growth. This could be beneficial, or it could perhaps lead to nuisance conditions. However, the experience of the last two dry years, with reduced delta outflow and sediment input, has been that algae growth has been reduced (8). More research must be done before these effects can be well understood.

Another possible result of decreased sediment input to the bay could be a long-term increase in the average grain size of the bottom material, that is, a trend from a muddy to a sandy bottom. This could lead in turn to a shift in bottom-dwelling species and even a change in the fish that feed on such species. The extent to which this might happen, if at all, cannot be predicted at this time.

Another component of delta outflow which would be reduced as outflow is reduced is dissolved silica. Diatoms, the dominant algal type, require silica to form the shells which are typical of these algae. When silica is in short supply and other plant nutrients are plentiful, other algal types, perhaps less desirable, will be favored over diatoms. In this instance, however, it is believed that a shortage of silica is not actually threatened at the delta outflow rates being proposed. Again, the relationships and probable effects are not adequately understood.

In addition to suspended sediment, delta outflow carries substantial amounts of organic detritus (dead plant material, primarily.) Organic detritus from various sources, settling to the bottom, is the basic food source for the benthic community; bottom dwellers in turn are the food source for a number of fish species in the bay. It is not known to what extent benthic species in the bay depend on detritus inputs from the delta or how big an effect reductions in those inputs will have.

There is a consistent theme in all of the preceding discussions: Lack of sufficient information. This lack has been recognized and noted by

various agencies and individuals. As pointed out earlier, the probable timing of future increases in water demands throughout the State leaves a few years breathing space before really hard decisions must be made. This time must be used to perform the research necessary so that those decisions finally can be made in an informed way. Meanwhile, any interim decisions must be of a kind that will not foreclose protection of beneficial uses in the delta and bay.

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WATER QUALITY MANAGEMENT PLANS

ESTIMATED EFFECTS OF THE DRAFT AIR QUALITY MAINTENANCE PLAN RECOMMENDATIONS UPON WATER QUALITY

TECHNICAL MEMORANDUM 29

JANUARY, 1978

INTRODUCTION

Integration of the separate management plans contained in the Draft Environmental Management Plan begins with an assessment of the impacts one plan may have upon another. Based on that assessment, adjustments are made as necessary so that each plan is consistent with the others. This memorandum examines the effects the Air Quality Maintenance Plan (AQMP) recommendations, as presented in the December 1977 draft AQMP, would have upon water quality in general and the draft Water Quality Management Plan in particular.

AIR QUALITY MAINTENANCE PLAN SUMMARY RECOMMENDATIONS

The Air Quality Maintenance Plan encompasses a number of recommendations in four groupings: stationary sources; mobile sources; transportation controls; and, development and land use management. Some of these recommendations will have possible effects upon water quality while others will obviously not. The following list of recommendations is accompanied by an initial assessment of possible effects, identifying those recommendations for further discussion.

Recommendation	Water Quality Effects
STATIONARY SOURCES	
1. Use paints and other coatings that are water based and/or have a high solids content.	- Unknown-probably insignificant
2. Use closed systems for storage and transfer of organic liquids.	- None
3. Use best available control technology (BACT) on new and existing sources.	- Possible waste discharge increase

Recommendation	Water Quality Effects
4. Continue the review of new and modified industrial and commercial facilities (new source review).	- Possible reduced growth in industrial discharges
MOBILE SOURCES	
5. Implement more stringent vehicle exhaust emission controls.	- Negligible decrease in surface runoff pollutants e.g., particulates, lead
6. Implement inspection/maintenance program for light and heavy duty vehicles.	- "
7. Require heavy duty gasoline exhaust control devices on existing vehicles.	- "
TRANSPORTATION CONTROLS	
8. Increase tolls on bridges.	- None
9. Implement regional parking strategy to discourage private auto use and encourage high-occupancy auto use.	- None
10. Preferential parking for carpools and vanpools.	- None
11. Provide additional transit service.	- None
12. Increase bus and carpool lanes/ ramp metering.	- None
13. Implement an auto control zone in San Francisco central business district to reduce traffic.	- None
14. Provide more ride sharing services such as jitneys and vanpools.	- None
15. Develop more extensive bicycle systems.	- None
DEVELOPMENT AND LAND USE MANAGEMENT	
16. Achieve more compact development throughout the region by the year 2000.	- Possible significant reallocation of planned wastewater treatment services. Possible but undetermined changes in surface runoff.

It appears that recommendations for mobile sources and transportation controls will not significantly affect water quality. This is because transportation vehicles are not an inherent source of water pollution. Although motor vehicles produce air pollutants such as nitrogen oxides, sulfur dioxide (SO_2), hydrocarbons, carbon monoxide, particulates and asbestos (from brake linings) which can make their way to surface waters, the total quantity of such loadings is generally small when compared to total surface runoff loadings which accompany typical wet weather flows. In that the AQMP reduces emission levels of a number of pollutants, and most significantly total hydrocarbon emissions, the surface runoff pollutants will decrease slightly due to the AQMP. Overall, the water quality improvements from the AQMP are expected to be rather small, if not insignificant.

Transportation controls, by reducing the expected increase in vehicular travel, could reduce the expected increase in all air pollutants. This could result in moderated particulate and asbestos pollution of surface runoff. The specific amount is presently unquantifiable. This effect would not change any of the Water Quality Management Plan recommendations. Again, the overall reductions to be gained are estimated to be relatively small.

More significant impacts on water quality are likely to result from recommendations on stationary sources, and development and land use management. These impacts are discussed in the next section.

WATER QUALITY EFFECTS

Recommendations for stationary sources of air pollution that could affect water quality (or wastewater generation) include conversion to waterbase or high solids paints, BACT on sources, and new source review.

Conversion by paint manufacturers to a product mix stressing more water base paints might change the nature and quantity of industrial wastewater discharges to municipal sewers. The exact effect on municipal sewerage systems was not estimated but should be very small.

The requirement of BACT for air emissions is not included as a factor in current industrial waste flow prediction. BACT water spray systems used to control particulate emissions are now generally implemented and do not produce regionally significant flows. A few BACT control technologies now being developed have the potential to: reduce both air emissions and wastewater discharges; reduce one at the expense of the other; or reduce one without affecting the other. Most will not. Possible examples of sample BACT control measures, including an estimate of water quality effects are shown below:

Process	Technology	Probable Water Quality Effect
Organic Storage	Dual and parallel vapor recovery	None
Paint Spray Booth	Incinerator	None
Dry Cleaning	Closed system with vapor recovery	None
Auto Fill Operations	Secondary vacuum assist	None

While many of the BACT measures are expected to have no impact on water quality, other measures would have some impact on industrial discharges. As the BACT measures are specified, a more accurate assessment of water quality impacts will be possible.

New source review, as used in the context of the Air Quality Maintenance Plan, could conceivably reduce industrial growth, and concomitantly industrial wastewater discharges, below current projections. The effect of this upon the Water Quality Management Plan, or water quality in general, is difficult to calculate since the extent of such restraints presently is unknown. New source review is unlikely to cause an increase in wastewater discharges.

New source review may have an effect on the design of wastewater treatment facilities. Certain sewage sludge processing options such as incineration, heat drying, heat stabilization, pyrolysis, or wet air oxidation have the potential to, or do, produce air emissions. Due to new source review, these processes may have to be removed from consideration, or subject to stringent exhaust emission controls.

Development and land use management is not intended to reduce population growth, but to direct growth into specified, higher density areas. Thus the generation of wastewater in the region should not be affected, but the location would. Certain wastewater treatment facilities in urban areas would require additional capacity sooner under compact growth policies than under the current development patterns. Other facility construction could be delayed or cancelled. Population distribution until the year 2000 under compact growth has been calculated by ABAG staff. This distribution, aggregated by sewerage units, has been accommodated in the 20-year municipal waste treatment project list. The Water Quality Management Plan is now in conformance with the proposed development and land use management policies of the AQMP.

An assessment of the effects of compact growth upon surface runoff has been made by ABAG staff. Compact growth would:

1. provide preservation of some outlying area watersheds, estuarine systems and groundwater recharge areas,

2. produce net regional reduction of surface runoff, and

3. increase higher density development areas producing surface runoff.

The basic effect of compact growth upon surface runoff elements of the Water Quality Management Plan should be to increase the effectiveness of control measures. More per capita runoff would be generated in higher density areas where such measures as street sweeping could be more efficient. However, it is undetermined whether there would be an actual reduction in total mass of pollutants discharged to surface waters.

SUMMARY

Incidental, but uncalculable, benefits may accrue to Bay Area water quality as a result of reductions in vehicle air emission. Locally significant, but again unquantifiable, changes in wastewater generation may occur as a result of implementation of recommendations for stationary sources of air pollution. These changes can be accommodated by current and proposed regulations in the Water Quality Management Plan. Development and land use management proposals would affect the timing of a number of wastewater sewerage and treatment facilities. These changes have already been included in the Water Quality Management Plan. Possible benefits may also be realized from reduced surface runoff.

The apparent uncertainty as to the degree of future effects of the Air Quality Maintenance Plan is not critical to the Water Quality Management Plan. The air plan could be interpreted to, at times, control industrial growth, population location and transportation. The water quality plan would provide for the protection of Bay Area waters and the treatment of wastewaters from any source that requires treatment facilities. Thus, being more reactive, the water quality plan can accommodate a variety of future circumstances by the adoption of water quality objectives and effluent discharge requirements. Additionally, through periodic review and update of the Environmental Management Plan and the 20-year municipal facilities project list, future effects of the Air Quality Maintenance Plan can be incorporated into the Water Quality Management Plan.

WQ/Tech Memo 30/January 13, 1978
Peter Y. Chiu

WATER QUALITY MANAGEMENT PLANS

ESTIMATED MUNICIPAL AND NON-DISCRETE INDUSTRIAL WASTEWATER LOADS

AS AFFECTED BY

VARIOUS POPULATION PROJECTIONS

TECHNICAL MEMORANDUM NO. 30

January 13, 1978

The purpose of this technical memorandum is to estimate the pollutant loads from municipal and non-discrete industrial wastewater sources in the 208 planning area. Treated wastewater (effluent) loads, as affected by the ABAG Series 3 population projections, are estimated at a five year interval from 1975 to 2000.

Four sets of waste load projections are made using the following sets of population projections:

- o Base Case 1 (high projections) with compact growth (Tables 1 to 6)
- o Base Case 2 (low projections) with compact growth (Tables 7 to 11)
- o Base Case 1 without compact growth (Tables 12 to 16)
- o Base Case 2 without compact growth (Tables 17 to 21)

Discussion of the Base Case 1 and Base Case 2 population projections is included in the March 1977 summary report entitled, "Provisional Series 3 Projections." These two sets of population projections are made, using varying assumptions about both national and regional trends and local development policies. In general, Base Case 1 has higher population numbers than Base Case 2.

Discussion of the compact growth development pattern is presented in the October, 1977 issue paper entitled, "Statement on AQMP Compact Growth." The compact growth alternative represents a different distribution (but not the absolute number) of population growth for both Base Case 1 and Base Case 2. In general, it means that:

- o Local governments would take steps to limit the location of new development in a way that prevents urban sprawl.

- o In areas designated for new development the densities allowed would be increased somewhat.

- o Residential housing in central cities would be rebuilt over the next 15-20 years.

- o Jobs and homes would be brought together to reduce the number of home-to-work trips by automobile and to reduce the distance to be travelled between home and job.

The four sets of waste load projections for all the sewerage units are summarized in Tables A to D. Boundaries of the sewerage units are shown in Figure 1. In most cases, these boundaries are identical to those indicated in Figure 15-2 of the Water Quality Control Plan Report, San Francisco Bay Basin (Basin Plan). It should be noted that waste loads from Sewerage Units 51 to 59 are not estimated since there are no significant wastewater discharges in those areas.

In general, the four sets of load projections were estimated in the following manner.

<u>For the 1975 estimates</u>

- o The domestic and industrial flow data were obtained from the 201 project reports and environmental impact documents. Additional information on domestic flow was obtained from the summary of the self-monitoring program reports compiled by the Regional Water Quality Control Board (RWQCB) staff.

- o The population served by municipal wastewater treatment facilities was estimated on the basis of ABAG's Series 3 projections.

- o The unit flow rate (in gallons per capita per day) was then calculated on the basis of the estimated domestic flow and sewered population.

- o The treated wastewater (effluent) quality data (in milligrams per liter) for biochemical oxygen demand, total suspended solids, total nitrogen, total phosphorus, and ammonia nitrogen were obtained from the self-monitoring report summary compiled by the RWQCB. In a few instances, effluent quality was estimated by ABAG staff.

- o The pollutant loads were then calculated on the basis of the estimated flow and the reported effluent quality data.

<u>For the 1980 to 2000 estimates</u>

- o The population served by municipal wastewater treatment facilities was estimated on the basis of the four sets of population projections.

- o The unit flow rate (in gallons per capita per day) was obtained from the 201 project reports. No adjustments were made due to projected changes in household size and water conservation practices. It was determined that such changes would not affect the waste loads significantly (see Tech Memo No. 27).

- o The average dry weather flow was calculated by adding the previously calculated domestic flow to the estimated industrial flow given in the 201 projected reports.

- o The unit effluent loadings (in milligrams per liter) for biochemical oxygen demand and total suspended solids were estimated on the basis that the treated wastewater would have the same level of effluent quality as the monthly average required by the RWQCB. In most cases, the required quality would be 30 milligrams per liter for both biochemical oxygen demand and total suspended solids. It should be noted that the annual average load will actually be somewhat less than the monthly average in order to conform to the monthly average requirements consistently.

- o The unit effluent loadings (in milligrams per liter) for total nitrogen, total phosphorus, and ammonia nitrogen were estimated on the basis that the unit loadings of the treatment plant would be similar to the 1975 loadings of a comparable treatment plant.

- o The pollutant loads were then calculated on the basis of the estimated flow and the unit loadings. It should be emphasized that these are effluent loads, and they are not the same as loads to the receiving waters. Part of the effluent will be reclaimed or reused and will not be discharged into the receiving waters.

Conclusions

- o The current Bay Area population served by municipal wastewater collection and treatment facilities is about 94% of the total population.*

- o In the future, about 92 to 94% of the total population would be sewered, depending on the growth development pattern.*

- o By the year 2000, the sewered population would be about 93% of the total population under "compact growth" and 92% under "no compact growth" for both Base Case 1 and Base Case 2.*

- o The wastewater flow would increase as population increases.

- o Certain pollutant loads, such as organic matters, suspended solids, and ammonia nitrogen would decrease in the near future as better treatment for wastewater is achieved.

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*Excluding sewered population within sewerage units 51 to 59.

- After the year 1980, the pollutant loads would steadily increase as the wastewater flow increases.

- The projected total pollutant loads for "compact growth" and "no compact growth" are almost the same in both Base Cases, since compact growth development only represents a different distribution of the same number of people.

Table A

SUMMARY OF ESTIMATED MUNICIPAL AND NON-DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT - BASE CASE 1 WITH COMPACT GROWTH

Population and Wastewater Loads	1975	1980	1985	1990	1995	2000
Total Population (S.U. 1 to 59)	4,829,100	5,078,000	5,350,100	5,625,400	5,890,800	6,151,500
Sewered Population (S.U. 1 to 50)*	4,536,600	4,767,105	4,018,997	5,259,449	5,491,732	5,713,090
Average Dry Weather Flow (ADWF), in million gallons per day (mgd)	535	607	634	659	685	707
Biochemical Oxygen Demand (BOD_5), in pounds per day (ppd)	403,700	107,600	111,700	116,400	121,200	125,800
Total Suspended Solids (TSS), in pounds per day (ppd)	246,600	107,500	111,600	116,300	121,100	125,700
Total Nitrogen (TN), in pounds per day (ppd)	125,800	130,400	135,800	140,900	146,300	151,100
Total Phosphorus (TP), in pounds per day (ppd)	67,800	81,000	85,100	88,500	91,700	94,300
Ammonia Nitrogen ($N\text{-}NH_3$), in pounds per day (ppd)	82,100	63,000	65,400	68,200	71,000	73,700

*Excluding sewered population within sewerage units 51 to 59.

Table B

SUMMARY OF ESTIMATED MUNICIPAL AND NON-DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT -
BASE CASE 2 WITH COMPACT GROWTH

Population and Wastewater Loads	1975	1980	1985	1990	1995	2000
Total Population (S.U. 1 to 59)	4,829,100	4,983,600	5,152,200	5,284,200	5,374,300	5,418,600
Sewered Population (S.U. 1 to 50)*	4,536,600	4,701,047	4,847,207	4,964,246	5,031,462	5,063,409
Average Dry Weather Flow (ADWF), in million gallons per day (mgd)	535	600	617	630	639	643
Biochemical Oxygen Demand (BOD_5), in pounds per day (ppd)	403,700	106,400	109,000	111,500	112,800	113,300
Total Suspended Solids (TSS), in pounds per day (ppd)	246,600	106,300	108,900	111,400	112,700	113,200
Total Nitrogen (TN), in pounds per day (ppd)	125,800	128,800	132,000	134,800	136,700	137,700
Total Phosphorus (TP), in pounds per day (ppd)	67,800	80,100	82,500	84,400	85,700	86,300
Ammonia Nitrogen ($N\text{-}NH_3$), in pounds per day (ppd)	82,100	62,400	63,800	65,400	66,100	66,300

*Excluding sewered population within sewerage units 51 to 59.

Table C

SUMMARY OF ESTIMATED MUNICIPAL AND NON-DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT - BASE CASE 1 WITHOUT COMPACT GROWTH

Population and Wastewater Loads	1975	1980	1985	1990	1995	2000
Total Population (S.U. 1 to 59)	4,829,100	5,078,000	5,350,100	5,625,400	5,890,800	6,151,500
Sewered Population (S.U. 1 to 50)*	4,536,600	4,758,321	5,003,622	5,211,636	5,434,680	5,645,942
Average Dry Weather Flow (ADWF), in million gallons per day (mgd)	535	606	632	653	678	702
Biochemical Oxygen Demand (BOD_5), in pounds per day (ppd)	403,700	107,000	110,700	114,700	119,300	123,400
Total Suspended Solids (TSS), in pounds per day (ppd)	246,600	107,000	110,600	114,600	119,200	123,300
Total Nitrogen (TN), in pounds per day (ppd)	125,800	130,000	135,000	139,000	144,700	150,000
Total Phosphorus (TP), in pounds per day (ppd)	67,800	80,900	85,100	87,500	90,600	93,600
Ammonia Nitrogen ($N\text{-}NH_3$), in pounds per day (ppd)	82,100	62,800	64,700	67,000	70,000	72,900

*Excluding sewered population within sewerage units 51 to 59.

Table D

SUMMARY OF ESTIMATED MUNICIPAL AND NON-DISCRETE INDUSTRIAL WASTEWATER LOADS AFTER TREATMENT - BASECASE 2 WITHOUT COMPACT GROWTH

Population and Wastewater Loads	1975	1980	1985	1990	1995	2000
Total Population (S.U. 1 to 59)	4,829,100	4,983,600	5,152,200	5,284,200	5,374,300	5,418,600
Sewered Population (S.U. 1 to 50)*	4,536,600	4,692,785	4,836,457	4,922,652	4,980,646	5,000,150
Average Dry Weather Flow (ADWF), in million gallons per day (mgd)	535	599	615	623	631	635
Biochemical Oxygen Demand (BOD_5), in pounds per day (ppd)	403,700	105,600	107,800	109,500	111,200	111,900
Total Suspended Solids (TSS), in pounds per day (ppd)	246,600	105,500	107,700	109,400	111,100	111,800
Total Nitrogen (TN), in pounds per day (ppd)	125,800	128,500	131,300	132,500	134,200	135,300
Total Phosphorus (TP), in pounds per day (ppd)	67,800	80,100	82,800	83,500	84,400	84,900
Ammonia Nitrogen ($N-NH_3$), in pounds per day (ppd)	82,100	61,900	62,900	63,800	64,800	65,400

*Excluding sewered population within sewerage units 51 to 59.

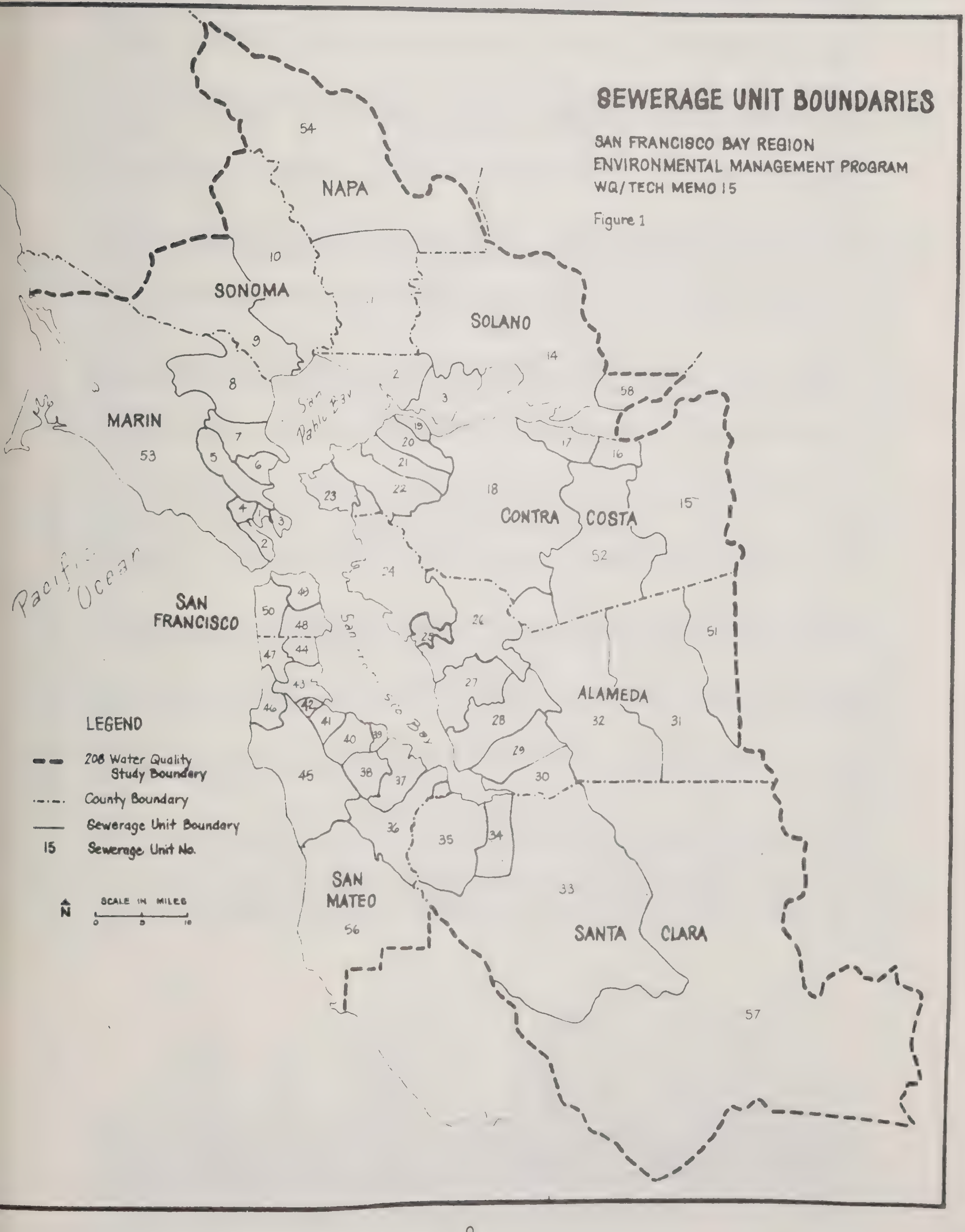
SEWERAGE UNIT BOUNDARIES
SAN FRANCISCO BAY REGION
ENVIRONMENTAL MANAGEMENT PROGRAM
WQ/TECH MEMO 15
Figure 1
LEGEND
208 Water Quality Study Boundary
County Boundary
Sewerage Unit Boundary
15 Sewerage Unit No.
SCALE IN MILES
0 5 10
N
NAPA
SONOMA
SOLANO
MARIN
CONTRA COSTA
SAN FRANCISCO
ALAMEDA
SAN MATEO
SANTA CLARA
Pacific Ocean
San Pablo Bay
San Francisco Bay

Table 1. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1975 (Base Year)

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	8240	97.1	.8	0.0	.8	11	73	20	133	35	234	24	160	24	160
2. Sausalito	13572	83.3	1.1	0.0	1.1	160	1508	67	631	31	292	6	57	24	226
3. Tiburon	7772	84.9	.7	0.0	.7	130	716	80	440	23	127	30	165	15	83
4. Mill Valley	17498	93.2	1.6	0.0	1.6	14	190	19	258	52	707	24	326	24	326
5. Ross Valley	53576	85.1	4.6	0.0	4.6	50	1902	32	1217	21	799	8	304	14	532
6. San Rafael-San Quentin	33123	132.5	4.4	0.0	4.4	32	1172	31	1135	35	1281	14	513	29	1062
7. Las Gallinas-Marin Bay	27990	75.4	2.1	0.0	2.1	27	475	29	510	35	616	27	475	32	563
8. Novato-Hamilton	43469	84.2	3.7	0.0	3.7	15	458	20	610	26	794	6	183	20	610
9. Petaluma	36148	101.3	3.7	0.0	3.7	52	1587	100	3052	30	916	21	641	25	763
10. Sonoma Valley	18993	101.6	1.9	0.0	1.9	24	386	20	322	30	483	21	338	25	402
11. Napa-American Canyon	54136	99.7	5.4	.3	5.7	22	1046	65	3090	10	475	5	238	1	48
12. Vallejo-Mare Island	73180	99.8	7.3[a]	.5	7.8[a]	140	9107	125	8131	33	2147	13	846	22	1431
13. Benicia	7573	87.2	.7	.3	1.0	110	917	64	534	42	350	7	58	17	142
14. Fairfield-Suisun-Travis	56993	94.7	7.4[a]	1.7	9.1[a]	22	1670	61	4630	22	1670	11	835	14	1063
15. East County*	7614	78.8	.6	0.0	.6	120	600	100	500	35	175	30	150	25	125
16. Antioch	33735	75.3	2.5	.1	2.6	71	1540	40	867	24	520	5	108	16	347
17. Pittsburg--Port Chicago	33656	101.6	3.4	.5	4.0	111	3657	65	2141	26	857	6	198	18	593
18. Central CCCSD-Mt. View	315592	103.0[b]	32.5	0.0	32.5	120	32526	79	21413	30	8131	8	2168	23	6234
19. Crockett- Port Costa	3790	68.6	.3	0.0	.3	208	451	62	134	27	59	9	20	16	35
20. Rodeo	6723	104.1	.7	0.0	.7	6	35	18	105	23	134	12	70	3	18
21. Pinole-Hercules	13374	97.2	1.3	0.0	1.3	7	76	21	228	34	369	12	130	5	54
22. San Pablo	58667	97.2	5.7	.3	6.0	4	200	5	250	24	1201	14	701	19	951
23. Richmond	51986	86.6	4.5	.9	5.4	19	856	37	1666	24	1081	29	1306	12	540
24. EBMUD	578274	112.9	65.3	11.3	76.6	210	134157	86	54941	36	22998	10	6388	20	12777
25. San Leandro	46483	71.0	3.3	3.4	6.7	22	1229	41	2291	5	279	45	2515	2	112
26. Oro Loma-Castro Valley	135258	94.6	12.8	.5	13.3	17	1886	33	3660	27	2995	44	4881	20	2218
27. Hayward	102329	93.8	9.6	1.7	11.3	55	5183	120	11309	21	1979	4	377	11	1037
28, 29,30.Union-Newark-Fremont	175236	79.9	14.0	1.8	15.8	64	8433	63	8302	30	3953	40	5271	22	2899
31. Livermore	48348	88.1	4.3	.3	4.6	10	382	12	458	25	955	10	382	1	38
32. VCSD-Pleasanton	59019	87.9	5.2	.1	5.3	10	441	6	265	31	1368	25	1103	1	44
33. San Jose-Santa Clara	845606	93.4	79.0	13.4	92.4	30	23118	24	18495	24	18495	22	16954	18	13871
34. Sunnyvale	105862	100.1	10.6	5.7	16.3	28	3806	72	9788	28	3806	21	2855	18	2447
35. Palo Alto	176847	119.3	21.1	6.9	28.0	19	4437	16	3736	27	6305	6	1401	24	5604
36. Menlo Park	50842	96.4	4.9	.6	5.5	17	780	15	688	30	1376	22	1009	26	1193
37. Redwood City	77245	93.2	7.2	1.0	8.2	195	13336	86	5881	32	2188	18	1231	20	1368
38. San Carlos-Belmont	51758	96.6	5.0	1.0	6.0	120	6005	78	3903	44	2202	18	901	15	751
39. Estero	22554	88.7	2.0	0.0	2.0	120	2002	70	1168	35	584	7	117	20	334
40. San Mateo	82131	127.8	10.5	0.0	10.5	116	10158	80	7006	36	3153	28	2452	21	1839
41. Burlingame	31674	94.7	3.0	.4	3.4	34	964	34	964	31	879	5	142	25	709
42. Millbrae	21533	111.5	2.4	0.0	2.4	15	300	20	400	30	600	22	440	26	520
43. SSF-Airport-San Bruno	79500	106.9	8.5	1.3	9.8	65	5313	21	1716	21	1716	4	327	16	1308
44. Guadalupe Valley**	22678	90.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	11316	88.4	1.0	0.0	1.0	120	1001	71	592	40	334	38	317	12	100
46. Pacifica	38245	91.5	3.5	0.0	3.5	140	4087	85	2481	38	1109	12	350	29	847
47. N. San Mateo	70354	66.8	4.7	0.0	4.7	210	8232	124	4861	39	1529	38	1490	28	1098
48. Southeast	157938	78.5	16.0 i,k	4.5	20.5	160	27355	78	13336	34	5813	7	1197	21	3590
49. North Point	306452	65.9	57.2 i	4.9	62.1	98	50756	49	25378	23	11912	8	4143	14	7251
50. Richmond-Sunset	208250	65.8	22.1 i	1.2	23.3	150	29148	67	13020	30	5830	8	1555	20	3884
TOTALS (S.U. 1-50)[r]	4536600		468	67	535		403656		246640		125775		67785		82148

Table 2. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1980 - Base Case 1 with Compact Growth

Sewerage Unit	Population served	Domestic Flows[s] gpcd	Domestic Flows[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	11190	85.00	.95	0.00	.95	30	238	30	238	30	238	20	159	20	159
2. Sausalito	15723	90.00	1.42	0.00	1.42	30	354	30	354	30	354	20	236	20	236
3. Tiburon	8060	100.00	.81	0.00	.81	30	202	30	202	30	202	20	134	20	134
4. Mill Valley	18203	85.00	1.55	0.00	1.55	30	387	30	387	30	387	20	258	20	258
5. Ross Valley	54808	85.00	4.66	0.00	4.66	30	1166	30	1166	30	1166	20	777	20	777
6. San Rafael-San Quentin	34480	122.00	4.21	0.00	4.21	30	1052	30	1052	30	1052	20	702	20	702
7. Las Gallinas-Marin Bay	28739	80.00	2.30	0.00	2.30	30	575	30	575	30	575	20	383	20	383
8. Novato-Hamilton	49991	90.00	4.50	0.00	4.50	30	1126	30	1126	30	1126	20	750	20	750
9. Petaluma	39662	100.00	3.97	0.00	3.97	30	992	30	992	30	992	20	662	20	662
10. Sonoma Valley	21166	100.00	2.12	0.00	2.12	30	530	30	530	30	530	20	353	20	353
11. Napa-American Canyon	55089	100.00	5.51	.30	5.81	5	242	15	727	10	484	5	242	3	145
12. Vallejo-Mare Island	78998	100.00	7.90[a]	.50	8.40[a]	30	2102	30	2102	30	2102	15	1051	20	1401
13. Benicia	11463	85.00	.97	.40	1.37	30	344	30	344	30	344	10	115	15	172
14. Fairfield-Suisun-Travis	61819	100.00	8.18[a]	3.20	11.38[a]	10	949	10	949	20	1899	20	1899	3	285
15. East County*	8448	85.00	.72	0.00	.72	30	180	30	180	20	120	10	60	15	90
16. Antioch	33472	80.00	2.68	.08	2.76	30	690	30	690	20	460	10	230	15	345
17. Pittsburg-Port Chicago	33730	85.00	2.87	.95	3.82	30	955	30	955	20	637	10	318	15	478
18. Central CCCSD-Mt. View	341747	103.00[b]	35.20	0.00	35.20	10	2936	10	2936	5	1469	1	294	3	881
19. Crockett- Port Costa	3850	100.00	.38	0.00	.38	30	96	30	96	30	96	10	32	15	48
20. Rodeo	10578	100.00	1.06	0.00	1.06	30	265	30	265	20	176	10	88	10	88
21. Pinole-Hercules	18899	100.00	1.89	0.00	1.89	30	473	30	473	30	473	10	158	15	236
22. San Pablo	61808	100.00	6.18	.43	6.61	30	1654	30	1654	25	1378	15	827	15	827
23. Richmond	51024	100.00	5.10	1.81	6.91	30	1729	30	1729	25	1441	30	1729	15	865
24. EBMUD	582779	113.00	65.85	11.30[l]	77.15	30	19304	30	19304	30	19304	10	6435	20	12869
25. San Leandro	45626	80.30	3.66	3.50	7.16	30	1792	30	1792	20	1195	40	2390	10	597
26. Oro Loma-Castro Valley	135024	90.10	12.17	.50	12.67	30	3169	30	3169	25	2641	40	4225	20	2113
27. Hayward	113770	102.00	11.60	7.20[l]	18.80	30	4705	30	4705	20	3137	10	1568	10	1568
28, 29,30. Union-Newark-Fremont	195828	78.50	15.37	2.30	17.67	30	4422	30	4422	30	4422	40	5896	20	2948
31. Livermore	46566	93.20	4.34	.30	4.64	30	1161	30	1161	30	1161	30	1161	20	774
32. VCSD-Pleasanton	72667	90.00	6.54	1.30	7.84	30	1962	30	1962	30	1962	30	1962	20	1308
33. San Jose-Santa Clara	934575	100.00	93.46	41.80[l]	135.26	10	11280	10	11280	25	28201	20	22561	3	3384
34. Sunnyvale	102638	100.00	10.26	7.50[l]	17.76	10	1482	10	1482	25	3704	20	2963	3	444
35. Palo Alto	178105	100.00	18.81[c]	6.90	25.71	10	2144	10	2144	25	5361	10	2144	3	643
36. Menlo Park	51645	85.70	5.43[c]	.60	6.03	10	503	8	402	30	1508	20	1005	10	503
37. Redwood City	76004	89.70	7.62[d]	1.00	8.62	10	719	8	575	30	2156	20	1437	10	719
38. San Carlos-Belmont	51605	83.30	4.30	1.00	5.30	10	442	8	354	30	1326	20	884	10	442
39. Estero	25324	80.00	2.23[e]	0.00	2.23	10	186	8	149	30	557	20	371	20	371
40. San Mateo	88272	100.00	10.53[f]	0.00	10.53	10	878	8	702	30	2634	20	1756	20	1756
41. Burlingame	37265	100.00	3.73	.40	4.13	30	1032	30	1032	30	1032	10	344	20	688
42. Millbrae	23168	100.00	2.32	0.00	2.32	30	580	30	580	30	580	20	386	20	386
43. SSF-Airport-San Bruno	78079	92.00	8.18[g]	1.30	9.48	30	2373	30	2373	20	1582	5	395	15	1185
44. Guadalupe Valley**	28049	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	13902	85.00	1.48[j]	0.00	1.48	30	371	30	371	30	371	30	371	15	185
46. Pacifica	46805	85.00	3.98	0.00	3.98	30	995	30	995	30	995	15	498	20	664
47. N. San Mateo	73746	94.00	6.93	0.00	6.93	30	1734	30	1734	30	1734	30	1734	20	1156
48. Southeast	151974	90.00[t]	19.00[u,m]	4.40	23.40[i]	30	5855	30	5855	30	5855	10	1952	[illegible]	[illegible]
49. North Point	303332	163.00[t]	59.84[u]	4.70	64.54[i]	30	16149	30	16149	30	16149	10	5383	[illegible]	1076[illegible]
50. Richmond-Sunset	205201	87.00[t]	19.25[u]	1.20	20.45[i]	30	5117	30	5117	30	5117	10	1706	20	3411
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	4767105		502	105	607		107590		107529		130382		80984		6306[illegible]

Table 3. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1985 - Base Case 1 with Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	10867	85.00	.92	0.00	.92	30	231	30	231	30	231	20	154	20	154
2. Sausalito	19133	90.00	1.72	0.00	1.72	30	431	30	431	30	431	20	287	20	287
3. Tiburon	8321	100.00	.83	0.00	.83	30	208	30	208	30	208	20	139	20	139
4. Mill Valley	18457	85.00	1.57	0.00	1.57	30	393	30	393	30	393	20	262	20	262
5. Ross Valley	56422	85.00	4.80	0.00	4.80	30	1200	30	1200	30	1200	20	800	20	800
6. San Rafael-San Quentin	35999	122.00	4.39	0.00	4.39	30	1099	30	1099	30	1099	20	733	20	733
7. Las Gallinas-Marin Bay	28760	80.00	2.30	0.00	2.30	30	576	30	576	30	576	20	384	20	384
8. Novato-Hamilton	54605	90.00	4.91	0.00	4.91	30	1230	30	1230	30	1230	20	820	20	820
9. Petaluma	47936	100.00	4.79	0.00	4.79	30	1199	30	1199	30	1199	20	800	20	800
10. Sonoma Valley	23916	100.00	2.39	0.00	2.39	30	598	30	598	30	598	20	399	20	399
11. Napa-American Canyon	56601	100.00	5.66	.30	5.96	5	249	15	746	10	497	5	249	3	149
12. Vallejo-Mare Island	87803	100.00	8.78[a]	.50	9.28[a]	30	2322	30	2322	30	2322	15	1161	20	1548
13. Benicia	14765	85.00	1.26	.50	1.76	30	439	30	439	30	439	10	146	15	220
14. Fairfield-Suisun-Travis	66190	100.00	8.62[d]	3.40	12.02[d]	10	1002	10	1002	20	2005	20	2005	3	301
15. East County*	9679	85.00	.82	0.00	.82	30	206	30	206	20	137	10	69	15	103
16. Antioch	34813	80.00	2.79	.09	2.88	30	719	30	719	20	480	10	240	15	360
17. Pittsburg-Port Chicago	34825	85.00	2.96	1.10	4.06	30	1016	30	1016	20	677	10	339	15	508
18. Central CCCSD-Mt. View	377021	103.00[b]	38.83	0.00	38.83	10	3239	10	3239	5	1619	1	324	3	972
19. Crockett- Port Costa	3952	100.00	.40	0.00	.40	30	99	30	99	30	99	10	33	15	49
20. Rodeo	11410	100.00	1.14	0.00	1.14	30	285	30	285	20	190	10	95	10	95
21. Pinole-Hercules	18140	100.00	1.81	0.00	1.81	30	454	30	454	30	454	10	151	15	227
22. San Pablo	65378	100.00	6.54	.48	7.02	30	1756	30	1756	25	1463	15	878	15	878
23. Richmond	50800	100.00	5.08	1.86	6.94	30	1736	30	1736	25	1447	30	1736	15	868
24. EBMUD	600737	113.00	67.88	11.30[i]	79.18	30	19812	30	19812	30	19812	10	6604	20	13208
25. San Leandro	46235	80.30	3.71	3.50	7.21	30	1805	30	1805	20	1203	40	2406	10	602
26. Oro Loma-Castro Valley	139745	90.10	12.59	.50	13.09	30	3275	30	3275	25	2729	40	4367	20	2184
27. Hayward	124464	102.00	12.70	7.20[i]	19.90	30	4978	30	4978	20	3319	10	1659	10	1659
28, 29,30.Union-Newark-Fremont	224651	78.50	17.64	2.30	19.94	30	4988	30	4988	30	4988	40	6650	20	3325
31. Livermore	44582	93.20	4.16	.30	4.46	30	1115	30	1115	30	1115	30	1115	20	743
32. VCSD-Pleasanton	80026	90.00	7.20	1.30	8.50	30	2127	30	2127	30	2127	30	2127	20	1418
33. San Jose-Santa Clara	1009754	100.00	100.98	42.90[i]	143.88	10	11999	10	11999	25	29998	20	23998	3	3600
34. Sunnyvale	99185	100.00	9.92	9.00[i]	18.92	10	1578	10	1578	25	3945	20	3156	3	473
35. Palo Alto	183102	100.00	19.31[c]	6.90	26.21	10	2186	10	2186	25	5465	10	2186	3	656
36. Menlo Park	54104	85.70	5.64[c]	.60	6.24	10	520	8	416	30	1560	20	1040	10	520
37. Redwood City	76751	89.70	7.68[d]	1.00	8.68	10	724	8	579	30	2173	20	1449	10	724
38. San Carlos-Belmont	52599	83.30	4.38[e]	1.00	5.38	10	449	8	359	30	1346	20	898	10	449
39. Estero	28943	80.00	2.52	0.00	2.52	10	210	8	168	30	629	20	420	20	420
40. San Mateo	98162	100.00	11.52[f]	0.00	11.52	10	960	8	768	30	2881	20	1921	20	1921
41. Burlingame	40140	100.00	4.01	.40	4.41	30	1104	30	1104	30	1104	10	368	20	736
42. Millbrae	24188	100.00	2.42	0.00	2.42	30	605	30	605	30	605	20	403	20	403
43. SSF-Airport-San Bruno	75330	92.00	7.93[g]	1.30	9.23	30	2309	30	2309	20	1540	5	385	15	1155
44. Guadalupe Valley**	27765	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	17554	85.00	1.79[j]	0.00	1.79	30	448	30	448	30	448	30	448	15	224
46. Pacifica	57058	85.00	4.85	0.00	4.85	30	1213	30	1213	30	1213	15	607	20	809
47. N. San Mateo	75493	94.00	7.10	0.00	7.10	30	1776	30	1776	30	1776	30	1776	20	1184
48. Southeast	146580	90.00[t]	18.49[u,n]	4.30	22.79[i]	30	5702	30	5702	30	5702	10	1901	20	3802
49. North Point	303741	163.00[t]	59.91[u]	4.50	64.41[i]	30	16115	30	16115	30	16115	10	5372	20	10744
50. Richmond-Sunset	201020	87.00[t]	18.89[u]	1.20	20.09[i]	30	5026	30	5026	30	5026	10	1675	20	3351
TOTALS (S.U. 1-50,SEWERED POP. ONLY)[r]	5018997		527	108	634		111712		111637		135815		85132		65362

Table 4. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1990 - Base Case 1 with Compact Growth

Sewerage Unit	Population served	Domestic Flows[s] gpcd	Domestic Flows[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	12433	85.00	1.06	0.00	1.06	30	264	30	264	30	264	20	176	20	176
2. Sausalito	20274	90.00	1.82	0.00	1.82	30	457	30	457	30	457	20	304	20	304
3. Tiburon	8424	100.00	.84	0.00	.84	30	211	30	211	30	211	20	141	20	141
4. Mill Valley	18617	85.00	1.58	0.00	1.58	30	396	30	396	30	396	20	264	20	264
5. Ross Valley	57262	85.00	4.87	0.00	4.87	30	1218	30	1218	30	1218	20	812	20	812
6. San Rafael-San Quentin	37650	122.00	4.59	0.00	4.59	30	1149	30	1149	30	1149	20	766	20	766
7. Las Gallinas-Marin Bay	28339	80.00	2.27	0.00	2.27	30	567	30	567	30	567	20	378	20	378
8. Novato-Hamilton	57885	90.00	5.21	0.00	5.21	30	1303	30	1303	30	1303	20	869	20	869
9. Petaluma	59215	100.00	5.92	0.00	5.92	30	1482	30	1482	30	1482	20	988	20	988
10. Sonoma Valley	27859	100.00	2.79	0.00	2.79	30	697	30	697	30	697	20	465	20	465
11. Napa-American Canyon	59631	100.00	5.96	.30	6.26	5	261	15	784	10	522	5	261	3	157
12. Vallejo-Mare Island	91846	100.00	9.18[a]	.50	9.68[a]	30	2423	30	2423	30	2423	15	1212	20	1615
13. Benicia	18506	85.00	1.57	.50	2.07	30	519	30	519	30	519	10	173	15	259
14. Fairfield-Suisun-Travis	71906	100.00	9.19[a]	3.50	12.69[a]	10	1058	10	1058	20	2117	20	2117	3	318
15. East County*	11101	85.00	.94	0.00	.94	30	236	30	236	20	157	10	79	15	118
16. Antioch	37648	80.00	3.01	.10	3.11	30	779	30	779	20	519	10	260	15	389
17. Pittsburg-Port Chicago	37931	85.00	3.22	1.16	4.38	30	1097	30	1097	20	731	10	366	15	548
18. Central CCCSD-Mt. View	415820	103.00[b]	42.83	0.00	42.83	10	3572	10	3572	5	1786	1	357	3	1072
19. Crockett-Port Costa	4041	100.00	.40	0.00	.40	30	101	30	101	30	101	10	34	15	51
20. Rodeo	15417	100.00	1.54	0.00	1.54	30	386	30	386	20	257	10	129	10	129
21. Pinole-Hercules	25783	100.00	2.58	0.00	2.58	30	645	30	645	30	645	10	215	15	323
22. San Pablo	68932	100.00	6.89	.50	7.39	30	1850	30	1850	25	1541	15	925	15	925
23. Richmond	51163	100.00	5.12	1.90	7.02	30	1755	30	1755	25	1463	30	1755	15	878
24. EBMUD	633225	113.00	71.55	11.30	82.85	30	20730	30	20730	30	20730	10	6910	20	13820
25. San Leandro	47209	80.30	3.79	3.50	7.29	30	1824	30	1824	20	1216	40	2432	10	608
26. Oro Loma-Castro Valley	138730	90.10	12.50	.50	13.00	30	3252	30	3252	25	2710	40	4337	20	2168
27. Hayward	130858	102.00	13.35	7.20	20.55	30	5141	30	5141	20	3427	10	1714	10	1714
28, 29, 30. Union-Newark-Fremont	224612	78.50	17.63	2.30	19.93	30	4987	30	4987	30	4987	40	6649	20	3325
31. Livermore	57255	93.20	5.34	.30	5.64	30	1410	30	1410	30	1410	30	1410	20	940
32. VCSD-Pleasanton	94350	90.00	8.49	1.30	9.79	30	2450	30	2450	30	2450	30	2450	20	1633
33. San Jose-Santa Clara	1020214	100.00	102.02	43.90	145.92	10	12170	10	12170	25	30425	20	24340	3	3651
34. Sunnyvale	97670	100.00	9.77	9.00	18.77	10	1565	10	1565	25	3913	20	3130	3	470
35. Palo Alto	194415	100.00	20.44[c]	6.90	27.34	10	2280	10	2280	25	5701	10	2280	3	684
36. Menlo Park	54328	85.70	5.66[c]	.60	6.26	10	522	8	417	30	1565	20	1043	10	522
37. Redwood City	76474	89.70	7.66[d]	1.00	8.66	10	722	8	578	30	2167	20	1444	10	722
38. San Carlos-Belmont	52571	83.30	4.38	1.00	5.38	10	449	8	359	30	1346	20	897	10	449
39. Estero	29334	80.00	2.55[e]	0.00	2.55	10	212	8	170	30	637	20	425	20	425
40. San Mateo	114311	100.00	13.13[f]	0.00	13.13	10	1095	8	876	30	3285	20	2190	20	2190
41. Burlingame	40295	100.00	4.03	.40	4.43	30	1108	30	1108	30	1108	10	369	20	739
42. Millbrae	24523	100.00	2.45	0.00	2.45	30	614	30	614	30	614	20	409	20	409
43. SSF-Airport-San Bruno	74258	92.00	7.83[g]	1.30	9.13	30	2285	30	2285	20	1523	5	381	15	1142
44. Guadalupe Valley**	33352	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	30938	85.00	2.93[j]	0.00	2.93	30	733	30	733	30	733	30	733	15	367
46. Pacifica	58485	85.00	4.97	0.00	4.97	30	1244	30	1244	30	1244	15	622	20	829
47. N. San Mateo	98494	94.00	9.26	0.00	9.26[i]	30	2316	30	2316	30	2316	30	2316	20	1544
48. Southeast	142786	90.00[t]	18.65[u,o]	4.20	22.85[i]	30	5718	30	5718	30	5718	10	1906	[illegible]	[illegible]
49. North Point	307300	163.00[t]	60.49[u]	4.30	64.79[i]	30	16210	30	16210	30	16210	10	5403	20	10807
50. Richmond-Sunset	196468	87.00[t]	18.49[u]	1.20	19.69[i]	30	4927	30	4927	30	4927	10	1642	20	3285
TOTALS (S.U. 1-50. SEWERED POP. ONLY)[r]	5259449		551	109	659		116391		116314		140889		88479		68197

Table 5. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1995 - Base Case 1 with Compact Growth

Sewerage Unit	Population served	Domestic Flows[s] gpcd	Domestic Flows[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	15119	85.00	1.29	0.00	1.29	30	322	30	322	30	322	20	214	20	214
2. Sausalito	22723	90.00	2.05	0.00	2.05	30	512	30	512	30	512	20	341	20	341
3. Tiburon	8616	100.00	.86	0.00	.86	30	216	30	216	30	216	20	144	20	144
4. Mill Valley	20917	85.00	1.78	0.00	1.78	30	445	30	445	30	445	20	297	20	297
5. Ross Valley	59605	85.00	5.07	0.00	5.07	30	1268	30	1268	30	1268	20	845	20	845
6. San Rafael-San Quentin	38443	122.00	4.69	0.00	4.69	30	1173	30	1173	30	1173	20	782	20	782
7. Las Gallinas-Marin Bay	33134	80.00	2.65	0.00	2.65	30	663	30	663	30	663	20	442	20	442
8. Novato-Hamilton	63553	90.00	5.72	0.00	5.72	30	1431	30	1431	30	1431	20	954	20	954
9. Petaluma	65679	100.00	6.57	0.00	6.57	30	1643	30	1643	30	1643	20	1096	20	1096
10. Sonoma Valley	32867	100.00	3.29	0.00	3.29	30	822	30	822	30	822	20	548	20	548
11. Napa-American Canyon	62943	100.00	6.29	.30	6.59	5	275	15	825	10	550	5	275	3	165
12. Vallejo-Mare Island	95014	100.00	9.50 [a]	.50	10.00[a]	30	2502	30	2502	30	2502	15	1251	20	1668
13. Benicia	26801	85.00	2.28	.60	2.88	30	720	30	720	30	720	10	240	15	360
14. Fairfield-Suisun-Travis	83455	100.00	10.35 [a]	3.60	13.95[a]	10	1163	10	1163	20	2326	20	2326	3	349
15. East County*	14514	85.00	1.23	0.00	1.23	30	309	30	309	20	206	10	103	15	154
16. Antioch	40575	80.00	3.25	.11	3.36	30	840	30	840	20	560	10	280	15	420
17. Pittsburg-Port Chicago	40837	85.00	3.47	1.23	4.70	30	1176	30	1176	20	784	10	392	15	588
18. Central CCCSD-Mt. View	430526	103.00[b]	44.34	0.00	44.34	10	3698	10	3698	5	1849	1	370	3	1109
19. Crockett- Port Costa	4430	100.00	.44	0.00	.44	30	111	30	111	30	111	10	37	15	55
20. Rodeo	17770	100.00	1.78	0.00	1.78	30	445	30	445	20	296	10	148	10	148
21. Pinole-Hercules	28790	100.00	2.88	0.00	2.88	30	720	30	720	30	720	10	240	15	360
22. San Pablo	72588	100.00	7.26	.52	7.78	30	1946	30	1946	25	1622	15	973	15	973
23. Richmond	54787	100.00	5.48	1.95	7.43	30	1859	30	1859	25	1549	30	1859	15	929
24. EBMUD	673775	113.00	76.14	11.30[l]	87.44	30	21877	30	21877	30	21877	10	7292	20	14584
25. San Leandro	49139	80.30	3.95	3.50	7.45	30	1863	30	1863	20	1242	40	2484	10	621
26. Oro Loma-Castro Valley	138502	90.10	12.48	.50	12.98	30	3247	30	3247	25	2706	40	4330	20	2165
27. Hayward	140644	102.00	14.35	7.20[l]	21.55	30	5391	30	5391	20	3594	10	1797	10	1797
28, 29, 30. Union-Newark-Fremont	221243	78.50	17.37	2.30	19.67	30	4921	30	4921	30	4921	40	6561	20	3281
31. Livermore	68758	93.20	6.41	.30	6.71	30	1678	30	1678	30	1678	30	1678	20	1119
32. VCSD-Pleasanton	101307	90.00	9.12	1.40	10.52	30	2632	30	2632	30	2632	30	2632	20	1754
33. San Jose-Santa Clara	1043961	100.00	104.40	45.00[l]	149.40	10	12460	10	12460	25	31149	20	24919	3	3738
34. Sunnyvale	97235	100.00	9.72	9.00[l]	18.72	10	1562	10	1562	25	3904	20	3123	3	468
35. Palo Alto	203498	100.00	21.35 [c]	6.90	28.25	10	2356	10	2356	25	5890	10	2356	3	707
36. Menlo Park	65709	85.70	6.63 [c]	.60	7.23	10	603	8	482	30	1809	20	1206	10	603
37. Redwood City	80044	89.70	7.98 [d]	1.00	8.98	10	749	8	599	30	2247	20	1498	10	749
38. San Carlos-Belmont	53279	83.30	4.44	1.00	5.44	10	454	8	363	30	1361	20	907	10	454
39. Estero	28924	80.00	2.51 [e]	0.00	2.51	10	210	8	168	30	629	20	419	20	419
40. San Mateo	116321	100.00	13.33 [f]	0.00	13.33	10	1112	8	890	30	3336	20	2224	20	2224
41. Burlingame	42785	100.00	4.28	.40	4.68	30	1171	30	1171	30	1171	10	390	20	780
42. Millbrae	26033	100.00	2.60	0.00	2.60	30	651	30	651	30	651	20	434	20	434
43. SSF-Airport-San Bruno	73384	92.00	8.25 [h]	1.30	9.55	30	2390	30	2390	20	1593	5	398	15	1195
44. Guadalupe Valley**	39935	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	30480	85.00	2.89 [j]	0.00	2.89	30	723	30	723	30	723	30	723	15	362
46. Pacifica	60817	85.00	5.17	0.00	5.17	30	1293	30	1293	30	1293	15	647	20	[illegible]
47. N. San Mateo	104906	94.00	9.86	0.00	9.86	30	2467	30	2467	30	2467	30	2467	20	1645
48. Southeast	141160	90.00[t]	19.10 [u,p]	4.20	23.30[i]	30	5829	30	5829	30	5829	10	1943	20	3886
49. North Point	313680	163.00[t]	61.53 [u]	4.20	65.73[i]	30	16446	30	16446	30	16446	10	5482	20	10964
50. Richmond-Sunset	194465	87.00[t]	18.32 [u]	1.20	19.52[i]	30	4884	30	4884	30	4884	10	1628	20	3256
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	5491732		575	110	685		121225		121150		146321		91696		71010

Table 6. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 2000 - Base Case 1 with Compact Growth

Sewerage Unit	Population served	Domestic Flows[s] gpcd	Domestic Flows[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	15095	85.00	1.28	0.00	1.28	30	321	30	321	30	321	20	214	20	21[illegible]
2. Sausalito	23872	90.00	2.15	0.00	2.15	30	538	30	538	30	538	20	358	20	358
3. Tiburon	10154	100.00	1.02	0.00	1.02	30	254	30	254	30	254	20	169	20	169
4. Mill Valley	21546	85.00	1.83	0.00	1.83	30	458	30	458	30	458	20	305	20	305
5. Ross Valley	66605	85.00	5.66	0.00	5.66	30	1416	30	1416	30	1416	20	944	20	944
6. San Rafael-San Quentin	39369	122.00	4.80	0.00	4.80	30	1202	30	1202	30	1202	20	801	20	801
7. Las Gallinas-Marin Bay	36717	80.00	2.94	0.00	2.94	30	735	30	735	30	735	20	490	20	490
8. Novato-Hamilton	75477	90.00	6.79	0.00	6.79	30	1700	30	1700	30	1700	20	1133	20	1133
9. Petaluma	73581	100.00	7.36	0.00	7.36	30	1841	30	1841	30	1841	20	1227	20	1227
10. Sonoma Valley	40355	100.00	4.04	0.00	4.04	30	1010	30	1010	30	1010	20	673	20	673
11. Napa-American Canyon	67186	100.00	6.72	.30	7.02	5	293	15	878	10	585	5	293	3	176
12. Vallejo-Mare Island	102783	100.00	10.28[a]	.50	10.78[a]	30	2697	30	2697	30	2697	15	1348	20	1798
13. Benicia	26362	85.00	2.24	.60	2.84	30	711	30	711	30	711	10	237	15	355
14. Fairfield-Suisun-Travis	101098	100.00	12.11[a]	3.70	15.81[a]	10	1319	10	1319	20	2637	20	2637	3	396
15. East County*	38848	85.00	3.30	0.00	3.30	30	826	30	826	20	551	10	275	15	413
16. Antioch	52860	80.00	4.23	.11	4.34	30	1086	30	1086	20	724	10	362	15	543
17. Pittsburg-Port Chicago	51846	85.00	4.41	1.27	5.68	30	1420	30	1420	20	947	10	473	15	710
18. Central CCCSD-Mt. View	440282	103.00[b]	45.35	0.00	45.35	10	3782	10	3782	5	1891	1	378	3	1135
19. Crockett-Port Costa	4586	100.00	.46	0.00	.46	30	115	30	115	30	115	10	38	15	57
20. Rodeo	18831	100.00	1.88	0.00	1.88	30	471	30	471	20	314	10	157	10	157
21. Pinole-Hercules	31484	100.00	3.15	0.00	3.15	30	788	30	788	30	788	10	263	15	394
22. San Pablo	71909	100.00	7.19	.57	7.76	30	1942	30	1942	25	1618	15	971	15	971
23. Richmond	56637	100.00	5.66	2.00	7.66	30	1917	30	1917	25	1598	30	1917	15	959
24. EBMUD	721656	113.00	81.55	11.30[l]	92.85	30	23230	30	23230	30	23230	10	7743	20	15487
25. San Leandro	51966	80.30	4.17	3.50	7.67	30	1920	30	1920	20	1280	40	2560	10	640
26. Oro Loma-Castro Valley	137166	90.10	12.36	.50	12.86	30	3217	30	3217	25	2681	40	4290	20	2145
27. Hayward	139379	102.00	14.22	7.20[l]	21.42	30	5358	30	5358	20	3572	10	1786	10	1786
28, 29,30, Union-Newark-Fremont	218236	78.50	17.13	2.30	19.43	30	4862	30	4862	30	4862	40	6482	20	3241
31. Livermore	67731	93.20	6.31	.30	6.61	30	1654	30	1654	30	1654	30	1654	20	1103
32. VCSD-Pleasanton	99864	90.00	8.99	1.40	10.39	30	2599	30	2599	30	2599	30	2599	20	1733
33. San Jose-Santa Clara	1049888	100.00	104.99	46.00[l]	150.99	10	12592	10	12592	25	31481	20	25185	3	3778
34. Sunnyvale	97100	100.00	9.71	9.00	18.71	10	1560	10	1560	25	3901	20	3121	3	468
35. Palo Alto	214145	100.00	22.41[c]	6.90	29.31	10	2445	10	2445	25	6112	10	2445	3	733
36. Menlo Park	70022	85.70	7.00[c]	.60	7.60	10	634	8	507	30	1902	20	1268	10	634
37. Redwood City	79908	89.70	7.97[d]	1.00	8.97	10	748	8	598	30	2244	20	1496	10	748
38. San Carlos-Belmont	54088	83.30	4.51	1.00	5.51	10	459	8	367	30	1377	20	918	10	459
39. Estero	28553	80.00	2.48[e]	0.00	2.48	10	207	8	166	30	622	20	414	20	414
40. San Mateo	119387	100.00	13.64[f]	0.00	13.64	10	1137	8	910	30	3412	20	2275	20	2275
41. Burlingame	45988	100.00	4.60	.40	5.00	30	1251	30	1251	30	1251	10	417	20	834
42. Millbrae	27982	100.00	2.80	0.00	2.80	30	700	30	700	30	700	20	467	20	467
43. SSF-Airport-San Bruno	72685	92.00	8.19[h]	1.30	9.49	30	2374	30	2374	20	1582	5	396	15	1187
44. Guadalupe Valley**	41081	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	29999	85.00	2.85[j]	0.00	2.85	30	713	30	713	30	713	30	713	15	357
46. Pacifica	59912	85.00	5.09	0.00	5.09	30	1274	30	1274	30	1274	15	637	20	849
47. N. San Mateo	113770	94.00	10.69	0.00	10.69	30	2676	30	2676	30	2676	30	2676	20	1784
48. Southeast	139800	90.00[t]	19.08[u,q]	4.00	23.08[j]	30	5774	30	5774	30	5774	10	1925	20	3850
49. North Point	320964	163.00[t]	62.72[u]	4.00	66.72[j]	30	16693	30	16693	30	16693	10	5564	20	11128
50. Richmond-Sunset	192803	87.00[t]	18.17[u]	1.20	19.37[j]	30	4847	30	4847	30	4847	10	1616	20	3232
TOTALS (S.U. 1-50. SEWERED POP. ONLY)[r]	5713090		596	111	707		125766		125714		151090		94313		7371[illegible]

Table 7. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1980 - Base Case 2 with Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	10916	85.00	.93	0.00	.93	30	232	30	232	30	232	20	155	20	155
2. Sausalito	15656	90.00	1.41	0.00	1.41	30	353	30	353	30	353	20	235	20	235
3. Tiburon	7908	100.00	.79	0.00	.79	30	198	30	198	30	198	20	132	20	132
4. Mill Valley	18164	85.00	1.54	0.00	1.54	30	386	30	386	30	386	20	258	20	258
5. Ross Valley	53588	85.00	4.55	0.00	4.55	30	1140	30	1140	30	1140	20	760	20	760
6. San Rafael-San Quentin	33767	122.00	4.12	0.00	4.12	30	1031	30	1031	30	1031	20	687	20	687
7. Las Gallinas-Marin Bay	27837	80.00	2.23	0.00	2.23	30	557	30	557	30	557	20	371	20	371
8. Novato-Hamilton	46168	90.00	4.16	0.00	4.16	30	1040	30	1040	30	1040	20	693	20	693
9. Petaluma	35362	100.00	3.54	0.00	3.54	30	885	30	885	30	885	20	590	20	590
10. Sonoma Valley	19714	100.00	1.97	0.00	1.97	30	493	30	493	30	493	20	329	20	329
11. Napa-American Canyon	53113	100.00	5.31 [a]	.30	5.61 [a]	5	234	15	702	10	468	5	234	3	140
12. Vallejo-Mare Island	77438	100.00	7.74	.50	8.24	30	2063	30	2063	30	2063	15	1031	20	1375
13. Benicia	11097	85.00	.94 [a]	.40	1.34 [a]	30	336	30	336	30	336	10	112	15	168
14. Fairfield-Suisun-Travis	59255	100.00	7.93 [a]	3.20	11.13 [a]	10	928	10	928	20	1856	20	1856	3	278
15. East County*	8259	85.00	.70	0.00	.70	30	176	30	176	20	117	10	59	15	88
16. Antioch	32727	80.00	2.62	.08	2.70	30	675	30	675	20	450	10	225	15	338
17. Pittsburg-Port Chicago	33020	85.00 [b]	2.81	.95	3.76	30	940	30	940	20	627	10	313	15	470
18. Central CCCSD-Mt. View	342978	103.00	35.33	0.00	35.33	10	2946	10	2946	5	1473	1	295	3	884
19. Crockett- Port Costa	3772	100.00	.38	0.00	.38	30	94	30	94	30	94	10	31	15	47
20. Rodeo	10566	100.00	1.06	0.00	1.06	30	264	30	264	20	176	10	88	10	88
21. Pinole-Hercules	18427	100.00	1.84	0.00	1.84	30	461	30	461	30	461	10	154	15	231
22. San Pablo	62126	100.00	6.21	.43	6.64	30	1662	30	1662	25	1385	15	831	15	831
23. Richmond	49659	100.00	4.97	1.81 [l]	6.78	30	1695	30	1695	25	1413	30	1695	15	848
24. EBMUD	574447	113.00	64.91	11.30	76.21	30	19068	30	19068	30	19068	10	6356	20	12712
25. San Leandro	44743	80.30	3.59	3.50	7.09	30	1775	30	1775	20	1183	40	2366	10	592
26. Oro Loma-Castro Valley	133302	90.10	12.01	.50 [l]	12.51	30	3130	30	3130	25	2608	40	4174	20	2087
27. Hayward	115650	102.00	11.80	7.20	19.00	30	4753	30	4753	20	3169	10	1584	10	1584
28, 29,30.Union-Newark-Fremont	201133	78.50	15.79	2.30	18.09	30	4526	30	4526	30	4526	40	6034	20	3017
31. Livermore	45112	93.20	4.20	.30	4.50	30	1127	30	1127	30	1127	30	1127	20	751
32. VCSD-Pleasanton	75553	90.00	6.80	1.30 [l]	8.10	30	2027	30	2027	30	2027	30	2027	20	1351
33. San Jose-Santa Clara	913506	100.00	91.35	41.80 [l]	133.15	10	11105	10	11105	25	27762	20	22210	3	3331
34. Sunnyvale	100937	100.00	10.09 [c]	7.50	17.59	10	1467	10	1467	25	3668	20	2935	3	440
35. Palo Alto	173809	100.00	18.38 [c]	6.90	25.28	10	2108	10	2108	25	5271	10	2108	3	633
36. Menlo Park	50948	85.70	5.37 [d]	.60	5.97	10	498	8	398	30	1493	20	995	10	498
37. Redwood City	75028	89.70	7.53	1.00	8.53	10	711	8	569	30	2134	20	1423	10	711
38. San Carlos-Belmont	51720	83.30	4.31 [e]	1.00	5.31	10	443	8	354	30	1328	20	885	10	443
39. Estero	25844	80.00	2.27 [f]	0.00	2.27	10	189	8	151	30	567	20	378	20	378
40. San Mateo	89085	100.00	10.61	0.00	10.61	10	885	8	708	30	2654	20	1769	20	1769
41. Burlingame	39667	100.00	3.97	.40	4.37	30	1093	30	1093	30	1093	10	364	20	728
42. Millbrae	23759	100.00	2.38	0.00	2.38	30	594	30	594	30	594	20	396	20	396
43. SSF-Airport-San Bruno	75976	92.00	7.99 [g]	1.30	9.29	30	2324	30	2324	20	1550	5	387	15	1162
44. Guadalupe Valley**	27615	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	[illegible]
45. Montara-Granada-Half Moon Bay	14565	85.00	1.54 [j]	0.00	1.54	30	385	30	385	30	385	30	385	15	19[illegible]
46. Pacifica	47325	85.00	4.02	0.00	4.02	30	1006	30	1006	30	1006	15	503	20	67[illegible]
47. N. San Mateo	72547	94.00 [t]	6.82	0.00	6.82	30	1706	30	1706	30	1706	30	1706	20	113[illegible]
48. Southeast	147873	90.00 [t]	18.59 [u,m]	4.40	22.99 [i]	30	5753	30	5753	30	5753	10	1918	20	383[illegible]
49. North Point	296577	163.00 [t]	58.74 [u]	4.70	63.44 [i]	30	15873	30	15873	30	15873	10	5291	20	1058[illegible]
50. Richmond-Sunset	202423	87.00	19.01 [u]	1.20	20.21 [i]	30	5057	30	5057	30	5057	10	1686	20	337[illegible]
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	4701047		495	105	600		106392		106315		128836		80142		6236[illegible]

Table 8. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1985 - Base Case 2 with Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	10421	85.00	.89	0.00	.89	30	222	30	222	30	222	20	148	20	148
2. Sausalito	18489	90.00	1.66	0.00	1.66	30	416	30	416	30	416	20	278	20	278
3. Tiburon	8025	100.00	.80	0.00	.80	30	201	30	201	30	201	20	134	20	134
4. Mill Valley	18097	85.00	1.54	0.00	1.54	30	385	30	385	30	385	20	257	20	257
5. Ross Valley	55707	85.00	4.74	0.00	4.74	30	1185	30	1185	30	1185	20	790	20	790
6. San Rafael-San Quentin	35701	122.00	4.36	0.00	4.36	30	1090	30	1090	30	1090	20	727	20	727
7. Las Gallinas-Marin Bay	27506	80.00	2.20	0.00	2.20	30	551	30	551	30	551	20	367	20	367
8. Novato-Hamilton	49193	90.00	4.43	0.00	4.43	30	1108	30	1108	30	1108	20	738	20	738
9. Petaluma	40995	100.00	4.10	0.00	4.10	30	1026	30	1026	30	1026	20	684	20	684
10. Sonoma Valley	21793	100.00	2.18	0.00	2.18	30	545	30	545	30	545	20	364	20	364
11. Napa-American Canyon	53732	100.00	5.37	.30	5.67	5	237	15	710	10	473	5	237	3	142
12. Vallejo-Mare Island	85121	100.00	8.51[a]	.50	9.01[a]	30	2255	30	2255	30	2255	15	1127	20	1503
13. Benicia	13994	85.00	1.19	.50	1.69	30	423	30	423	30	423	10	141	15	211
14. Fairfield-Suisun-Travis	62382	100.00	8.24[a]	3.40	11.64[a]	10	971	10	971	20	1941	20	1941	3	291
15. East County*	13687	85.00	1.16	0.00	1.16	30	291	30	291	20	194	10	97	15	146
16. Antioch	33324	80.00	2.67	.09	2.76	30	690	30	690	20	460	10	230	15	345
17. Pittsburg-Port Chicago	33388	85.00	2.84	1.10	3.94	30	985	30	985	20	657	10	328	15	493
18. Central CCCSD-Mt. View	378446	103.00[b]	38.98	0.00	38.98	10	3251	10	3251	5	1625	1	325	3	975
19. Crockett- Port Costa	3796	100.00	.38	0.00	.38	30	95	30	95	30	95	10	32	15	47
20. Rodeo	11084	100.00	1.11	0.00	1.11	30	277	30	277	20	185	10	92	10	92
21. Pinole-Hercules	17331	100.00	1.73	0.00	1.73	30	434	30	434	30	434	10	145	15	217
22. San Pablo	65247	100.00	6.52	.48	7.00	30	1753	30	1753	25	1460	15	876	15	876
23. Richmond	48445	100.00	4.84	1.86	6.70	30	1677	30	1677	25	1398	30	1677	15	839
24. EBMUD	593458	113.00	67.06	11.30[i]	78.36	30	19606	30	19606	30	19606	10	6535	20	13071
25. San Leandro	44617	80.30	3.58	3.50	7.08	30	1772	30	1772	20	1181	40	2363	10	591
26. Oro Loma-Castro Valley	136641	90.10	12.31	.50	12.81	30	3205	30	3205	25	2671	40	4274	20	2137
27. Hayward	119819	102.00	12.22	7.20[i]	19.42	30	4859	30	4859	20	3240	10	1620	10	1620
28, 29, 30. Union-Newark-Fremont	213647	78.50	16.77	2.30	19.07	30	4772	30	4772	30	4772	40	6362	20	3181
31. Livermore	42375	93.20	3.95	.30	4.25	30	1063	30	1063	30	1063	30	1063	20	709
32. VCSD-Pleasanton	75450	90.00	6.79	1.30	8.09	30	2024	30	2024	30	2024	30	2024	20	1349
33. San Jose-Santa Clara	943505	100.00	94.35	42.90[i]	137.25	10	11447	10	11447	25	28617	20	22893	3	3434
34. Sunnyvale	95947	100.00	9.59	9.00[i]	18.59	10	1551	10	1551	25	3877	20	3102	3	465
35. Palo Alto	172400	100.00	18.24[c]	6.90	25.14	10	2097	10	2097	25	5242	10	2097	3	629
36. Menlo Park	52147	85.70	5.47[c]	.60	6.07	10	506	8	405	30	1518	20	1012	10	506
37. Redwood City	73547	89.70	7.40[d]	1.00	8.40	10	700	8	560	30	2101	20	1401	10	700
38. San Carlos-Belmont	50761	83.30	4.23[e]	1.00	5.23	10	436	8	349	30	1308	20	872	10	436
39. Estero	27262	80.00	2.38	0.00	2.38	10	199	8	159	30	596	20	397	20	397
40. San Mateo	93873	100.00	11.09[f]	0.00	11.09	10	925	8	740	30	2774	20	1849	20	1849
41. Burlingame	40597	100.00	4.06	.40	4.46	30	1116	30	1116	30	1116	10	372	20	744
42. Millbrae	24150	100.00	2.41	0.00	2.41	30	604	30	604	30	604	20	403	20	403
43. SSF-Airport-San Bruno	72203	92.00	7.64[g]	1.30	8.94	30	2237	30	2237	20	1492	5	373	15	1119
44. Guadalupe Valley**	26951	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	29012	85.00	2.77[j]	0.00	2.77	30	692	30	692	30	692	30	692	15	346
46. Pacifica	60462	85.00	5.14	0.00	5.14	30	1286	30	1286	30	1286	15	643	20	857
47. N. San Mateo	73415	94.00	6.90	0.00	6.90	30	1727	30	1727	30	1727	30	1727	20	1151
48. Southeast	140320	90.00[t]	17.85[u,n]	4.30	22.15[i]	30	5543	30	5543	30	5543	10	1848	20	3695
49. North Point	293631	163.00[t]	58.26[u]	4.50	62.76[i]	30	15703	30	15703	30	15703	10	5234	20	10469
50. Richmond-Sunset	194281	87.00[t]	18.30[u]	1.20	19.50[i]	30	4880	30	4880	30	4880	10	1627	20	3253
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	4847207		509	108	617		109014		108934		131959		82516		63774

Table 9. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1990 - Base Case 2 with Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	11179	85.00	.95	0.00	.95	30	238	30	238	30	238	20	158	20	158
2. Sausalito	19355	90.00	1.74	0.00	1.74	30	436	30	436	30	436	20	291	20	291
3. Tiburon	7940	100.00	.79	0.00	.79	30	199	30	199	30	199	20	132	20	132
4. Mill Valley	17601	85.00	1.50	0.00	1.50	30	374	30	374	30	374	20	250	20	250
5. Ross Valley	54692	85.00	4.65	0.00	4.65	30	1163	30	1163	30	1163	20	775	20	775
6. San Rafael-San Quentin	36028	122.00	4.40	0.00	4.40	30	1100	30	1100	30	1100	20	733	20	733
7. Las Gallinas-Marin Bay	26704	80.00	2.14	0.00	2.14	30	535	30	535	30	535	20	356	20	356
8. Novato-Hamilton	51425	90.00	4.63	0.00	4.63	30	1158	30	1158	30	1158	20	772	20	772
9. Petaluma	50793	100.00	5.08	0.00	5.08	30	1271	30	1271	30	1271	20	847	20	847
10. Sonoma Valley	25275	100.00	2.53	0.00	2.53	30	632	30	632	30	632	20	422	20	422
11. Napa-American Canyon	55842	100.00	5.58	.30	5.88	5	245	15	736	10	491	5	245	3	147
12. Vallejo-Mare Island	87036	100.00	8.70 [a]	.50	9.20[a]	30	2303	30	2303	30	2303	15	1151	20	1535
13. Benicia	16654	85.00	1.42	.50	1.92	30	479	30	479	30	479	10	160	15	240
14. Fairfield-Suisun-Travis	66454	100.00	8.65 [a]	3.50	12.15[a]	10	1013	10	1013	20	2026	20	2026	3	304
15. East County*	14463	85.00	1.23	0.00	1.23	30	308	30	308	20	205	10	103	15	154
16. Antioch	34832	80.00	2.79	.10	2.89	30	722	30	722	20	481	10	241	15	361
17. Pittsburg-Port Chicago	35067	85.00	2.98	1.16	4.14	30	1036	30	1036	20	691	10	345	15	518
18. Central CCCSD-Mt. View	390078	103.00[b]	40.18	0.00	40.18	10	3351	10	3351	5	1675	1	335	3	1005
19. Crockett-Port Costa	3781	100.00	.38	0.00	.38	30	95	30	95	30	95	10	32	15	47
20. Rodeo	13999	100.00	1.40	0.00	1.40	30	350	30	350	20	234	10	117	10	117
21. Pinole-Hercules	23184	100.00	2.32	0.00	2.32	30	580	30	580	30	580	10	193	15	290
22. San Pablo	65502	100.00	6.55	.50	7.05	30	1764	30	1764	25	1470	15	882	15	882
23. Richmond	47752	100.00	4.78	1.90 [i]	6.68	30	1670	30	1670	25	1392	30	1670	15	835
24. EBMUD	610526	113.00	68.99	11.30 [i]	80.29	30	20088	30	20088	30	20088	10	6696	20	13392
25. San Leandro	45363	80.30	3.64	3.50	7.14	30	1787	30	1787	20	1191	40	2383	10	596
26. Oro Loma-Castro Valley	131643	90.10	11.86	.50 [i]	12.36	30	3093	30	3093	25	2577	40	4124	20	2062
27. Hayward	124060	102.00	12.65	7.20 [i]	19.85	30	4968	30	4968	20	3312	10	1656	10	1656
28, 29, 30. Union-Newark-Fremont	210661	78.50	16.54	2.30	18.84	30	4713	30	4713	30	4713	40	6284	20	3142
31. Livermore	54330	93.20	5.06	.30	5.36	30	1342	30	1342	30	1342	30	1342	20	895
32. VCSD-Pleasanton	88365	90.00	7.95	1.30	9.25	30	2315	30	2315	30	2315	30	2315	20	1543
33. San Jose-Santa Clara	942084	100.00	94.21	43.90 [i]	138.11	10	11518	10	11518	25	28796	20	23036	3	3455
34. Sunnyvale	93514	100.00	9.35	9.00	18.35	10	1531	10	1531	25	3826	20	3061	3	459
35. Palo Alto	182133	100.00	19.21 [c]	6.90	26.11	10	2178	10	2178	25	5445	10	2178	3	653
36. Menlo Park	51752	85.70	5.44 [c]	.60	6.04	10	503	8	403	30	1510	20	1007	10	503
37. Redwood City	72814	89.70	7.33 [d]	1.00	8.33	10	695	8	556	30	2085	20	1390	10	695
38. San Carlos-Belmont	50295	83.30	4.19	1.00	5.19	10	433	8	346	30	1298	20	866	10	433
39. Estero	27308	80.00	2.38 [e]	0.00	2.38	10	199	8	159	30	597	20	398	20	398
40. San Mateo	109244	100.00	12.62 [f]	0.00	12.62	10	1053	8	842	30	3159	20	2106	20	2106
41. Burlingame	40345	100.00	4.03	.40	4.43	30	1110	30	1110	30	1110	10	370	20	740
42. Millbrae	24189	100.00	2.42	0.00	2.42	30	605	30	605	30	605	20	403	20	403
43. SSF-Airport-San Bruno	70528	92.00	7.49 [g]	1.30	8.79	30	2199	30	2199	20	1466	5	366	15	1099
44. Guadalupe Valley**	32187	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	29484	85.00	2.81 [j]	0.00	2.81	30	702	30	702	30	702	30	702	[illegible]	351
46. Pacifica	57648	85.00	4.90	0.00	4.90	30	1226	30	1226	30	1226	15	613	[illegible]	817
47. N. San Mateo	95411	94.00	8.97	0.00	8.97	30	2244	30	2244	30	2244	30	2244	20	1496
48. Southeast	134804	90.00[t]	17.83 [u,q]	4.20	22.03[i]	30	5512	30	5512	30	5512	10	1837	20	3674
49. North Point	294668	163.00[t]	58.43 [u]	4.30	62.73[i]	30	15695	30	15695	30	15695	10	5232	20	10464
50. Richmond-Sunset	187680	87.00[t]	17.73 [u]	1.20	18.93[i]	30	4736	30	4736	30	4736	10	1579	[illegible]	3157
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	4964246		521	109	630		111465		111379		134775		84423		65362

Table 10. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1995 - Base Case 2 with Compact Growth

Sewerage Unit	Population served	Domestic Flows[s] gpcd	Domestic Flows[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	11369	85.00	.97	0.00	.97	30	242	30	242	30	242	20	161	20	161
2. Sausalito	19260	90.00	1.73	0.00	1.73	30	434	30	434	30	434	20	289	20	289
3. Tiburon	7849	100.00	.78	0.00	.78	30	196	30	196	30	196	20	131	20	131
4. Mill Valley	17519	85.00	1.49	0.00	1.49	30	373	30	373	30	373	20	248	20	248
5. Ross Valley	54213	85.00	4.61	0.00	4.61	30	1153	30	1153	30	1153	20	769	20	769
6. San Rafael-San Quentin	35550	122.00	4.34	0.00	4.34	30	1085	30	1085	30	1085	20	723	20	723
7. Las Gallinas-Marin Bay	27188	80.00	2.18	0.00	2.18	30	544	30	544	30	544	20	363	20	363
8. Novato-Hamilton	53576	90.00	4.82	0.00	4.82	30	1206	30	1206	30	1206	20	804	20	804
9. Petaluma	55731	100.00	5.57	0.00	5.57	30	1394	30	1394	30	1394	20	930	20	930
10. Sonoma Valley	28714	100.00	2.87	0.00	2.87	30	718	30	718	30	718	20	479	20	479
11. Napa-American Canyon	57866	100.00	5.79	.30	6.09	5	254	15	761	10	508	5	254	3	152
12. Vallejo-Mare Island	87542	100.00	8.75 a	.50	9.25a	30	2315	30	2315	30	2315	15	1158	20	1544
13. Benicia	17729	85.00	1.51	.60	2.11	30	527	30	527	30	527	10	176	15	264
14. Fairfield-Suisun-Travis	72275	100.00	9.23 a	3.60	12.83a	10	1070	10	1070	20	2140	20	2140	3	321
15. East County*	16560	85.00	1.41	0.00	1.41	30	352	30	352	20	235	10	117	15	176
16. Antioch	35433	80.00	2.83	.11	2.94	30	737	30	737	20	491	10	246	15	368
17. Pittsburg-Port Chicago	35714	85.00	3.04	1.23	4.27	30	1067	30	1067	20	712	10	356	15	534
18. Central CCCSD-Mt. View	386261	103.00 b	39.78	0.00	39.78	10	3318	10	3318	5	1659	1	332	3	995
19. Crockett-Port Costa	3808	100.00	.38	0.00	.38	30	95	30	95	30	95	10	32	15	48
20. Rodeo	14434	100.00	1.44	0.00	1.44	30	361	30	361	20	241	10	120	10	120
21. Pinole-Hercules	24122	100.00	2.41	0.00	2.41	30	604	30	604	30	604	10	201	15	302
22. San Pablo	64683	100.00	6.47	.52	6.99	30	1748	30	1748	25	1457	15	874	15	874
23. Richmond	47284	100.00	4.73	1.95 l	6.68	30	1671	30	1671	25	1392	30	1671	15	835
24. EBMUD	612135	113.00	69.17	11.30 l	80.47	30	20134	30	20134	30	20134	10	6711	20	13423
25. San Leandro	45316	80.30	3.64	3.50	7.14	30	1786	30	1786	20	1191	40	2382	10	595
26. Oro Loma-Castro Valley	129589	90.10	11.68	.50 l	12.18	30	3046	30	3046	25	2539	40	4062	20	2031
27. Hayward	131505	102.00	13.41	7.20 l	20.61	30	5158	30	5158	20	3438	10	1719	10	1719
28, 29,30.Union-Newark-Fremont	205429	78.50	16.13	2.30	18.43	30	4610	30	4610	30	4610	40	6147	20	3073
31. Livermore	62868	93.20	5.86	.30	6.16	30	1541	30	1541	30	1541	30	1541	20	1027
32. VCSD-Pleasanton	93431	90.00	8.41	1.40 l	9.81	30	2454	30	2454	30	2454	30	2454	20	1636
33. San Jose-Santa Clara	958186	100.00	95.82	45.00 l	140.82	10	11744	10	11744	25	29361	20	23489	3	3523
34. Sunnyvale	92584	100.00	9.26	9.00	18.26	10	1523	10	1523	25	3807	20	3046	3	457
35. Palo Alto	189262	100.00	19.93 c	6.90	26.83	10	2237	10	2237	25	5593	10	2237	3	671
36. Menlo Park	62066	85.70	6.32 c	.60	6.92	10	577	8	462	30	1731	20	1154	10	577
37. Redwood City	75657	89.70	7.59 d	1.00	8.59	10	716	8	573	30	2148	20	1432	10	716
38. San Carlos-Belmont	50596	83.30	4.21	1.00	5.21	10	435	8	348	30	1305	20	870	10	435
39. Estero	26680	80.00	2.33 e	0.00	2.33	10	195	8	156	30	584	20	389	20	389
40. San Mateo	110416	100.00	12.74 f	0.00	12.74	10	1063	8	850	30	3188	20	2125	20	2125
41. Burlingame	42384	100.00	4.24	.40	4.64	30	1161	30	1161	30	1161	10	387	20	774
42. Millbrae	25485	100.00	2.55	0.00	2.55	30	638	30	638	30	638	20	425	20	425
43. SSF-Airport-San Bruno	69236	92.00	7.87 h	1.30	9.17	30	2294	30	2294	20	1530	5	382	15	1147
44. Guadalupe Valley**	37096	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	28630	85.00	2.73 j	0.00	2.73	30	684	30	684	30	684	30	684	15	342
46. Pacifica	56632	85.00	4.81	0.00	4.81	30	1204	30	1204	30	1204	15	602	20	803
47. N. San Mateo	96664	94.00	9.09	0.00	9.09	30	2273	30	2273	30	2273	30	2273	20	1516
48. Southeast	131986	90.00 t	18.02 u,n	4.20	22.22 l	30	5559	30	5559	30	5559	10	1853	[illegible]	[illegible]
49. North Point	293739	163.00 t	58.28 u	4.20	62.48 l	30	15632	30	15632	30	15632	10	5211	20	10422
50. Richmond-Sunset	184357	87.00 t	17.44 u	1.20	18.64 l	30	4663	30	4663	30	4663	10	1554	20	3109
TOTALS (S.U. 1-50,SEWERED POP. ONLY)[r]	5031462		529	110	639		112794		112704		136690		85704		66073

Table 11. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 2000 - Base Case 2 with Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	$N-NH_3$ mg/l	$N-NH_3$ ppd
1. Richardson Bay	12009	85.00	1.02	0.00	1.02	30	255	30	255	30	255	20	170	20	170
2. Sausalito	19311	90.00	1.74	0.00	1.74	30	435	30	435	30	435	20	290	20	290
3. Tiburon	7952	100.00	.80	0.00	.80	30	199	30	199	30	199	20	133	20	133
4. Mill Valley	17784	85.00	1.51	0.00	1.51	30	378	30	378	30	378	20	252	20	252
5. Ross Valley	54220	85.00	4.61	0.00	4.61	30	1153	30	1153	30	1153	20	769	20	769
6. San Rafael-San Quentin	35380	122.00	4.32	0.00	4.32	30	1080	30	1080	30	1080	20	720	20	720
7. Las Gallinas-Marin Bay	27422	80.00	2.19	0.00	2.19	30	549	30	549	30	549	20	366	20	366
8. Novato-Hamilton	54798	90.00	4.93	0.00	4.93	30	1234	30	1234	30	1234	20	823	20	823
9. Petaluma	59036	100.00	5.90	0.00	5.90	30	1477	30	1477	30	1477	20	985	20	985
10. Sonoma Valley	31685	100.00	3.17	0.00	3.17	30	793	30	793	30	793	20	529	20	529
11. Napa-American Canyon	59758	100.00	5.98	.30	6.28	5	262	15	785	10	523	5	262	3	157
12. Vallejo-Mare Island	88067	100.00	8.81[a]	.50	9.31[a]	30	2329	30	2329	30	2329	15	1164	20	1552
13. Benicia	18183	85.00	1.55	.60	2.15	30	537	30	537	30	537	10	179	15	268
14. Fairfield-Suisun-Travis	75239	100.00	9.52[d]	3.70	13.22[a]	10	1103	10	1103	20	2206	20	2206	3	331
15. East County*	18544	85.00	1.58	0.00	1.58	30	394	30	394	20	263	10	131	15	197
16. Antioch	35977	80.00	2.88	.11	2.99	30	748	30	748	20	498	10	249	15	375
17. Pittsburg-Port Chicago	36256	85.00	3.08	1.27	4.35	30	1089	30	1089	20	726	10	363	15	544
18. Central CCCSD-Mt. View	383665	103.00[b]	39.52	0.00	39.52	10	3296	10	3296	5	1648	1	330	3	989
19. Crockett- Port Costa	3805	100.00	.38	0.00	.38	30	95	30	95	30	95	10	32	15	48
20. Rodeo	14591	100.00	1.46	0.00	1.46	30	365	30	365	20	243	10	122	10	122
21. Pinole-Hercules	24511	100.00	2.45	0.00	2.45	30	613	30	613	30	613	10	204	15	307
22. San Pablo	64119	100.00	6.41	.57	6.98	30	1747	30	1747	25	1456	15	873	15	873
23. Richmond	47139	100.00	4.71	2.00	6.71	30	1680	30	1680	25	1400	30	1680	15	840
24. EBMUD	618810	113.00	69.93	11.30[l]	81.23	30	20323	30	20323	30	20323	10	6774	20	13548
25. San Leandro	45735	80.30	3.67	3.50	7.17	30	1795	30	1795	20	1196	40	2393	10	598
26. Oro Loma-Castro Valley	128147	90.10	11.55	.50	12.05	30	3014	30	3014	25	2512	40	4019	20	2009
27. Hayward	129753	102.00	13.23	7.20[l]	20.43	30	5113	30	5113	20	3409	10	1704	10	1704
28, 29,30. Union-Newark-Fremont	202209	78.50	15.87	2.30	18.17	30	4547	30	4547	30	4547	40	6063	20	3031
31. Livermore	61883	93.20	5.77	.30	6.07	30	1518	30	1518	30	1518	30	1518	20	1012
32. VCSD-Pleasanton	91756	90.00	8.26	1.40	9.66	30	2416	30	2416	30	2416	30	2416	20	1611
33. San Jose-Santa Clara	968290	100.00	96.83	46.00[l]	142.83	10	11912	10	11912	25	29780	20	23824	3	3574
34. Sunnyvale	92793	100.00	9.28	9.00[l]	18.28	10	1524	10	1524	25	3811	20	3049	3	457
35. Palo Alto	201199	100.00	21.12[c]	6.90	28.02	10	2337	10	2337	25	5842	10	2337	3	701
36. Menlo Park	65244	85.70	6.59[c]	.60	7.19	10	600	8	480	30	1799	20	1200	10	600
37. Redwood City	75492	89.70	7.57[d]	1.00	8.57	10	715	8	572	30	2145	20	1430	10	715
38. San Carlos-Belmont	50807	83.30	4.23	1.00	5.23	10	436	8	349	30	1309	20	873	10	436
39. Estero	26293	80.00	2.30[e]	0.00	2.30	10	192	8	154	30	576	20	384	20	384
40. San Mateo	111292	100.00	12.83[f]	0.00	12.83	10	1070	8	856	30	3210	20	2140	20	2140
41. Burlingame	43207	100.00	4.32	.40	4.72	30	1181	30	1181	30	1181	10	394	20	787
42. Millbrae	25981	100.00	2.60	0.00	2.60	30	650	30	650	30	650	20	433	20	433
43. SSF-Airport-San Bruno	68393	92.00	7.79[h]	1.30	9.09	30	2275	30	2275	20	1517	5	379	15	1137
44. Guadalupe Valley**	36979	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	28107	85.00	2.69[j]	0.00	2.69	30	673	30	673	30	673	30	673	1[illegible]	33[illegible]
46. Pacifica	55976	85.00	4.76	0.00	4.76	30	1190	30	1190	30	1190	15	595	2[illegible]	794
47. N. San Mateo	97876	94.00	9.20	0.00	9.20	30	2302	30	2302	30	2302	30	2302	20	1535
48. Southeast	130305	90.00[t]	17.86[u,q]	4.00	21.86[i]	30	5468	30	5468	30	5468	10	1823	20	3646
49. North Point	293615	163.00[t]	58.26[u]	4.00	62.26[i]	30	15577	30	15577	30	15577	10	5192	20	10385
50. Richmond-Sunset	182403	87.00[t]	17.27[u]	1.20	18.47[i]	30	4621	30	4621	30	4621	10	1540	[illegible]	[illegible]
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	5063409		532	111	643		113259		113180		137663		86285		66293

Table 12. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1980 - Base Case 1 without Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	10415	85.00	.88	0.00	.88	30	219	30	219	30	219	20	146	20	146
2. Sausalito	15014	90.00	1.35	0.00	1.35	30	338	30	338	30	338	20	225	20	225
3. Tiburon	8026	100.00	.80	0.00	.80	30	201	30	201	30	201	20	134	20	134
4. Mill Valley	17388	85.00	1.48	0.00	1.48	30	370	30	370	30	370	20	247	20	247
5. Ross Valley	54620	85.00	4.64	0.00	4.64	30	1162	30	1162	30	1162	20	774	20	774
6. San Rafael-San Quentin	34043	122.00	4.15	0.00	4.15	30	1039	30	1039	30	1039	20	693	20	693
7. Las Gallinas-Marin Bay	27422	80.00	2.19	0.00	2.19	30	549	30	549	30	549	20	366	20	366
8. Novato-Hamilton	47890	90.00	4.31	0.00	4.31	30	1078	30	1078	30	1078	20	719	20	719
9. Petaluma	40710	100.00	4.07	0.00	4.07	30	1019	30	1019	30	1019	20	679	20	679
10. Sonoma Valley	21612	100.00	2.16	0.00	2.16	30	541	30	541	30	541	20	360	20	360
11. Napa-American Canyon	55138	100.00	5.51	.30	5.81	5	242	15	727	10	485	5	242	3	145
12. Vallejo-Mare Island	77682	100.00	7.77 [a]	.50	8.27 [a]	30	2069	30	2069	30	2069	15	1034	20	1379
13. Benicia	11883	85.00	1.01	.40	1.41	30	353	30	353	30	353	10	118	15	176
14. Fairfield-Suisun-Travis	63390	100.00	8.34 [a]	3.20	11.54 [a]	10	962	10	962	20	1925	20	1925	3	289
15. East County*	8285	85.00	.70	0.00	.70	30	176	30	176	20	117	10	59	15	88
16. Antioch	33686	80.00	2.69	.08	2.77	30	694	30	694	20	463	10	231	15	347
17. Pittsburg-Port Chicago	33965	85.00	2.89	.95	3.84	30	960	30	960	20	640	10	320	15	480
18. Central CCCSD-Mt. View	345893	103.00 [b]	35.63	0.00	35.63	10	2971	10	2971	5	1486	1	297	3	891
19. Crockett-Port Costa	3730	100.00	.37	0.00	.37	30	93	30	93	30	93	10	31	15	47
20. Rodeo	11117	100.00	1.11	0.00	1.11	30	278	30	278	20	185	10	93	10	93
21. Pinole-Hercules	19730	100.00	1.97	0.00	1.97	30	494	30	494	30	494	10	165	15	247
22. San Pablo	63043	100.00	6.30	.43	6.73	30	1685	30	1685	25	1404	15	842	15	842
23. Richmond	49994	100.00	5.00	1.81	6.81	30	1704	30	1704	25	1420	30	1704	15	852
24. EBMUD	574548	113.00	64.92	11.30 [l]	76.22	30	19071	30	19071	30	19071	10	6357	20	12714
25. San Leandro	44545	80.30	3.58	3.50	7.08	30	1771	30	1771	20	1180	40	2361	10	590
26. Oro Loma-Castro Valley	135450	90.10	12.20	.50	12.70	30	3179	30	3179	25	2649	40	4238	20	2119
27. Hayward	111883	102.00	11.41	7.20 [l]	18.61	30	4657	30	4657	20	3104	10	1552	10	1552
28, 29,30. Union-Newark-Fremont	198215	78.50	15.56	2.30	17.86	30	4469	30	4469	30	4469	40	5958	20	2979
31. Livermore	47262	93.20	4.40	.30	4.70	30	1177	30	1177	30	1177	30	1177	20	785
32. VCSD-Pleasanton	68192	90.00	6.14	1.30	7.44	30	1861	30	1861	30	1861	30	1861	20	1241
33. San Jose-Santa Clara	932585	100.00	93.30	41.80 [l]	135.10	10	11267	10	11267	25	28168	20	22534	3	3380
34. Sunnyvale	[illegible]	100.00	10.53	7.50 [l]	18.03	10	1503	10	1503	25	3759	20	3007	3	451
35. Palo Alto	178317	100.00	18.83 [c]	6.90	25.73	10	2146	10	2146	25	5365	10	2146	3	644
36. Menlo Park	49335	85.70	5.23 [c]	.60	5.83	10	486	8	389	30	1458	20	972	10	486
37. Redwood City	79976	89.70	7.97 [d]	1.00	8.97	10	748	8	599	30	2245	20	1497	10	748
38. San Carlos-Belmont	51148	83.30	4.26	1.00	5.26	10	439	8	351	30	1316	20	877	10	439
39. Estero	25833	80.00	2.27 [e]	0.00	2.27	10	189	8	151	30	567	20	378	20	378
40. San Mateo	95357	100.00	11.24 [f]	0.00	11.24	10	937	8	750	30	2811	20	1874	20	1874
41. Burlingame	30516	100.00	3.09	.40	3.49	30	874	30	874	30	874	10	291	20	582
42. Millbrae	20801	100.00	2.08	0.00	2.08	30	520	30	520	30	520	20	347	20	347
43. SSF-Airport-San Bruno	77622	52.00	8.14 [g]	1.30	9.44	30	2362	30	2362	20	1575	5	394	15	1181
44. Guadalupe Valley**	24995	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	14277	85.00	1.51 [j]	0.00	1.51	30	379	30	379	30	379	30	379	15	189
46. Pacifica	47424	85.00	4.03	0.00	4.03	30	1009	30	1009	30	1009	15	504	20	672
47. N. San Mateo	76696	94.00	7.21	0.00	7.21	30	1804	30	1804	30	1804	30	1804	20	1203
48. Southeast	153057	90.00 [t]	18.82 [u,m]	4.40	23.22 [i]	30	5811	30	5811	30	5811	10	1937	20	3874
49. North Point	300521	163.00 [t]	59.38 [u]	4.70	64.08 [i]	30	16034	30	16034	30	16034	10	5345	20	10689
50. Richmond-Sunset	206901	87.00 [t]	19.40 [u]	1.20	20.60 [i]	30	5154	30	5154	30	5154	10	1718	20	3436
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	[illegible]		501	165	[illegible]		[illegible]		126969		130009		80913		[illegible]

Table 13. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1985 - Base Case 1 without Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	11215	95.00	.95	0.00	.95	30	239	30	239	30	239	20	159	20	159
2. Sausalito	16401	90.00	1.48	0.00	1.48	30	369	30	369	30	369	20	246	20	246
3. Tiburon	8463	100.00	.85	0.00	.85	30	212	30	212	30	212	20	141	20	141
4. Mill Valley	17436	85.00	1.48	0.00	1.48	30	371	30	371	30	371	20	247	20	247
5. Ross Valley	56291	85.00	4.78	0.00	4.78	30	1197	30	1197	30	1197	20	798	20	798
6. San Rafael-San Quentin	35160	122.00	4.29	0.00	4.29	30	1073	30	1073	30	1073	20	715	20	715
7. Las Gallinas-Marin Bay	27206	80.00	2.18	0.00	2.18	30	545	30	545	30	545	20	363	20	363
8. Novato-Hamilton	51794	90.00	4.66	0.00	4.66	30	1166	30	1166	30	1166	20	778	20	778
9. Petaluma	48519	100.00	4.85	0.00	4.85	30	1214	30	1214	30	1214	20	809	20	809
10. Sonoma Valley	24777	100.00	2.48	0.00	2.48	30	620	30	620	30	620	20	413	20	413
11. Napa-American Canyon	56705	100.00	5.67	.30	5.97	5	249	15	747	10	498	5	249	3	149
12. Vallejo-Mare Island	81982	100.00	8.20[a]	.50	8.70[a]	30	2176	30	2176	30	2176	15	1088	20	1451
13. Benicia	15992	85.00	1.36	.50	1.86	30	465	30	465	30	465	10	155	15	233
14. Fairfield-Suisun-Travis	69917	100.00	8.99[a]	3.40	12.39[a]	10	1033	10	1033	20	2067	20	2067	3	310
15. East County*	9318	85.00	.79	0.00	.79	30	198	30	198	20	132	10	66	15	99
16. Antioch	34739	80.00	2.78	.09	2.87	30	718	30	718	20	479	10	239	15	359
17. Pittsburg-Port Chicago	35460	85.00	3.01	1.10	4.11	30	1029	30	1029	20	686	10	343	15	515
18. Central CCCSD-Mt. View	382422	103.00[b]	39.39	0.00	39.39	10	3285	10	3285	5	1643	1	329	3	986
19. Crockett-Port Costa	3734	100.00	.37	0.00	.37	30	93	30	93	30	93	10	31	15	47
20. Rodeo	15773	100.00	1.58	0.00	1.58	30	395	30	395	20	263	10	132	10	132
21. Pinole-Hercules	26669	100.00	2.67	0.00	2.67	30	667	30	667	30	667	10	222	15	334
22. San Pablo	69153	100.00	6.92	.48	7.40	30	1850	30	1850	25	1542	15	925	15	925
23. Richmond	48636	100.00	4.86	1.86[l]	6.72	30	1682	30	1682	25	1402	30	1682	15	841
24. EBMUD	568911	113.00	64.29	11.30[l]	75.59	30	18912	30	18912	30	18912	10	6304	20	12608
25. San Leandro	43309	80.30	3.48	3.50	6.98	30	1746	30	1746	20	1164	40	2328	10	582
26. Oro Loma-Castro Valley	137333	90.10	12.37	.50[l]	12.87	30	3221	30	3221	25	2684	40	4295	20	2147
27. Hayward	124166	102.00	12.66	7.20[l]	19.86	30	4970	30	4970	20	3313	10	1657	10	1657
28, 29, 30. Union-Newark-Fremont	229777	78.50	18.04	2.30	20.34	30	5088	30	5088	30	5088	40	6785	20	3392
31. Livermore	48126	93.20	4.49	.30	4.79	30	1197	30	1197	30	1197	30	1197	20	798
32. VCSD-Pleasanton	82746	90.00	7.45	1.30[l]	8.75	30	2189	30	2189	30	2189	30	2189	20	1459
33. San Jose-Santa Clara	1011226	100.00	101.12	42.90[l]	144.02	10	12011	10	12011	25	30029	20	24023	3	3603
34. Sunnyvale	101884	100.00	10.19	9.00[l]	19.19	10	1600	10	1600	25	4001	20	3201	3	480
35. Palo Alto	182392	100.00	19.24[c]	6.90	26.14	10	2180	10	2180	25	5450	10	2180	3	654
36. Menlo Park	48619	85.70	5.17[c]	.60	5.77	10	481	8	385	30	1443	20	962	10	481
37. Redwood City	84268	89.70	8.36[d]	1.00	9.36	10	781	8	624	30	2342	20	1561	10	781
38. San Carlos-Belmont	51438	83.30	4.28[e]	1.00	5.28	10	441	8	353	30	1322	20	882	10	441
39. Estero	29644	90.00	2.57	0.00	2.57	10	214	8	172	30	643	20	429	20	429
40. San Mateo	110212	100.00	12.72[f]	0.00	12.72	10	1061	8	849	30	3183	20	2122	20	2122
41. Burlingame	30265	100.00	3.03	.40	3.43	30	858	30	858	30	858	10	286	20	572
42. Millbrae	20138	100.00	2.01	0.00	2.01	30	504	30	504	30	504	20	336	20	336
43. SSF-Airport-San Bruno	74520	92.00	7.89[g]	1.30	9.19	~~30~~	~~2300~~	~~30~~	~~2300~~	~~20~~	~~1533~~	~~5~~	~~383~~	~~15~~	~~1150~~
44. Guadalupe Valley**	25001	30.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	20415	85.00	2.04[j]	0.00	2.04	30	509	30	509	30	509	30	509	15	255
46. Pacifica	57775	85.00	4.91	0.00	4.91	30	1229	30	1229	30	1229	15	614	[illegible]	[illegible]
47. N. San Mateo	75471	94.00	7.09	0.00	7.09	30	1775	30	1775	30	1775	30	1775	[illegible]	118
48. Southeast	147553	90.00[t]	13.31[u,n]	4.30	22.63[i]	30	5662	30	5662	30	5662	10	1887	20	3775
49. North Point	297499	163.00[t]	58.89[u]	4.50	63.39[i]	30	15861	30	15861	30	15861	10	5287	20	10574
50. Richmond-Sunset	201493	87.00[t]	18.93[u]	1.20	20.13[i]	30	5036	30	5036	30	5036	10	1679	20	3358
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	5003622		524	108	632		110674		110577		135046		85068		64705

Table 14. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1990 - Base Case 1 without Compact Growth

Sewerage Unit	Population served	Domestic Flows[s] gpcd	Domestic Flows[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	13656	85.00	1.16	0.00	1.16	30	290	30	290	30	290	20	194	20	194
2. Sausalito	18974	90.00	1.71	0.00	1.71	30	427	30	427	30	427	20	285	20	285
3. Tiburon	9817	100.00	.98	0.00	.98	30	246	30	246	30	246	20	164	20	164
4. Mill Valley	19289	85.00	1.64	0.00	1.64	30	410	30	410	30	410	20	273	20	273
5. Ross Valley	60623	85.00	5.15	0.00	5.15	30	1289	30	1289	30	1289	20	860	20	860
6. San Rafael-San Quentin	35285	122.00	4.30	0.00	4.30	30	1077	30	1077	30	1077	20	718	20	718
7. Las Gallinas-Marin Bay	35265	80.00	2.82	0.00	2.82	30	706	30	706	30	706	20	471	20	471
8. Novato-Hamilton	74330	90.00	6.69	0.00	6.69	30	1674	30	1674	30	1674	20	1116	20	1116
9. Petaluma	56142	100.00	5.61	0.00	5.61	30	1405	30	1405	30	1405	20	936	20	936
10. Sonoma Valley	28198	100.00	2.82	0.00	2.82	30	706	30	706	30	706	20	470	20	470
11. Napa-American Canyon	59224	100.00	5.92	.30	6.22	5	259	15	778	10	519	5	259	3	156
12. Vallejo-Mare Island	93401	100.00	9.34[a]	.50	9.84[a]	30	2462	30	2462	30	2462	15	1231	20	1641
13. Benicia	27097	95.00	2.30	.50	2.80	30	701	30	701	30	701	10	234	15	351
14. Fairfield-Suisun-Travis	77302	100.00	9.73[a]	3.50	13.23[a]	10	1103	10	1103	20	2207	20	2207	3	331
15. East County*	12339	85.00	1.05	0.00	1.05	30	262	30	262	20	175	10	87	15	131
16. Antioch	37146	80.00	2.97	.10	3.07	30	769	30	769	20	512	10	256	15	384
17. Pittsburg-Port Chicago	41898	85.00	3.56	1.16	4.72	30	1181	30	1181	20	788	10	394	15	591
18. Central CCCSD-Mt. View	432030	103.00[b]	44.50	0.00	44.50	10	3711	10	3711	5	1856	1	371	3	1113
19. Crockett- Port Costa	4460	100.00	.45	0.00	.45	30	112	30	112	30	112	10	37	15	56
20. Rodeo	18683	100.00	1.87	0.00	1.87	30	467	30	467	20	312	10	156	10	156
21. Pinole-Hercules	31375	100.00	3.14	0.00	3.14	30	785	30	785	30	785	10	262	15	393
22. San Pablo	70846	100.00	7.08	.50	7.58	30	1898	30	1898	25	1581	15	949	15	949
23. Richmond	51258	100.00	5.13	1.90	7.03	30	1758	30	1758	25	1465	30	1758	15	879
24. EBMUD	576937	113.00	65.19	11.30[l]	76.49	30	19139	30	19139	30	19139	10	6380	20	12759
25. San Leandro	43243	80.30	3.47	3.50	6.97	30	1744	30	1744	20	1163	40	2326	10	581
26. Oro Loma-Castro Valley	136670	90.10	12.31	.50	12.81	30	3206	30	3206	25	2672	40	4275	20	2137
27. Hayward	131891	102.00	13.45	7.20[l]	20.65	30	5167	30	5167	20	3445	10	1722	10	1722
28, 29, 30. Union-Newark-Fremont	222891	78.50	17.50	2.30	19.80	30	4953	30	4953	30	4953	40	6604	20	3302
31. Livermore	62955	93.20	5.87	.30	6.17	30	1543	30	1543	30	1543	30	1543	20	1029
32. VCSD-Pleasanton	90568	90.00	8.15	1.30	9.45	30	2365	30	2365	30	2365	30	2365	20	1576
33. San Jose-Santa Clara	1009369	100.00	100.94	43.90[l]	144.84	10	12079	10	12079	25	30198	20	24159	3	3624
34. Sunnyvale	99212	100.00	9.92	9.00[l]	18.92	10	1578	10	1578	25	3945	20	3156	3	473
35. Palo Alto	193095	100.00	19.31[c]	6.90	26.21	10	2186	10	2186	25	5465	10	2186	3	656
36. Menlo Park	56145	85.70	5.81[c]	.60	6.41	10	535	8	428	30	1604	20	1070	10	535
37. Redwood City	86261	89.70	8.54[d]	1.00	9.54	10	795	8	636	30	2386	20	1591	10	795
38. San Carlos-Belmont	50721	83.30	4.23	1.00	5.23	10	436	8	349	30	1307	20	872	10	436
39. Estero	28826	80.00	2.51[e]	0.00	2.51	10	209	8	167	30	627	20	418	20	418
40. San Mateo	111804	100.00	12.88[f]	0.00	12.88	10	1074	8	859	30	3223	20	2148	20	2148
41. Burlingame	33514	100.00	3.35	.40	3.75	30	939	30	939	30	939	10	313	20	626
42. Millbrae	20041	100.00	2.00	0.00	2.00	30	501	30	501	30	501	20	334	20	334
43. SSF-Airport-San Bruno	73085	92.00	7.72[g]	1.30	9.02	30	2258	30	2258	20	1505	5	376	15	1127
44. Guadalupe Valley**	25648	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	27356	85.00	2.63[j]	0.00	2.63	30	657	30	657	30	657	30	657	15	328
46. Pacifica	60226	85.00	5.12	0.00	5.12	30	1281	30	1281	30	1281	15	640	20	854
47. N. San Mateo	75506	94.00	7.10	0.00	7.10	30	1776	30	1776	30	1776	30	1776	20	1184
48. Southeast	143748	90.00[t]	18.41[u]	4.20	22.61[i]	30	5656	30	5656	30	5656	10	1885	20	3771
49. North Point	302543	163.00[t]	59.71[u]	4.30	64.01[i]	30	16016	30	16016	30	16016	10	5339	20	10678
50. Richmond-Sunset	196945	87.00[t]	18.53[u]	1.20	19.73[i]	30	4938	30	4938	30	4938	10	1646	20	3292
TOTALS (S.U. 1-50.SEWERED POP. ONLY)[r]	5211636		545	109	653		114730		114639		139007		87468		67005

Table 15. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1995 - Base Case 1 without Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	13462	85.00	1.14	0.00	1.14	30	286	30	286	30	286	20	191	20	191
2. Sausalito	19691	90.00	1.77	0.00	1.77	30	443	30	443	30	443	20	296	20	296
3. Tiburon	9659	100.00	.97	0.00	.97	30	242	30	242	30	242	20	161	20	161
4. Mill Valley	19325	85.00	1.64	0.00	1.64	30	411	30	411	30	411	20	274	20	274
5. Ross Valley	61452	85.00	5.22	0.00	5.22	30	1307	30	1307	30	1307	20	871	20	871
6. San Rafael-San Quentin	35067	122.00	4.28	0.00	4.28	30	1070	30	1070	30	1070	20	714	20	714
7. Las Gallinas-Marin Bay	35045	80.00	2.80	0.00	2.80	30	701	30	701	30	701	20	468	20	468
8. Novato-Hamilton	80906	90.00	7.28	0.00	7.28	30	1822	30	1822	30	1822	20	1215	20	1215
9. Petaluma	63849	100.00	6.38	0.00	6.38	30	1598	30	1598	30	1598	20	1065	20	1065
10. Sonoma Valley	33877	100.00	3.39	0.00	3.39	30	848	30	848	30	848	20	565	20	565
11. Napa-American Canyon	64665	100.00	6.47	.30	6.77	5	282	15	846	10	564	5	282	3	169
12. Vallejo-Mare Island	95864	100.00	9.59 a	.50	10.09a	30	2524	30	2524	30	2524	15	1262	20	1682
13. Benicia	26810	85.00	2.28	.60	2.88	30	720	30	720	30	720	10	240	15	360
14. Fairfield-Suisun-Travis	90606	100.00	11.06 a	3.60	14.66a	10	1223	10	1223	20	2445	20	2445	3	367
15. East County*	17572	85.00	1.49	0.00	1.49	30	374	30	374	20	249	10	125	15	187
16. Antioch	40919	80.00	3.27	.11	3.38	30	847	30	847	20	564	10	282	15	423
17. Pittsburg-Port Chicago	43773	85.00	3.72	1.23	4.95	30	1239	30	1239	20	826	10	413	15	619
18. Central CCCSD-Mt. View	435451	103.00b	44.85	0.00	44.85	10	3741	10	3741	5	1870	1	374	3	1122
19. Crockett- Port Costa	4386	100.00	.44	0.00	.44	30	110	30	110	30	110	10	37	15	55
20. Rodeo	20224	100.00	2.02	0.00	2.02	30	506	30	506	20	337	10	169	10	169
21. Pinole-Hercules	32223	100.00	3.22	0.00	3.22	30	806	30	806	30	806	10	269	15	403
22. San Pablo	71541	100.00	7.15	.52	7.67	30	1920	30	1920	25	1600	15	960	15	960
23. Richmond	52444	100.00	5.24	1.95	7.19	30	1800	30	1800	25	1500	30	1800	15	900
24. EBMUD	623557	113.00	70.46	11.30 l	81.76	30	20457	30	20457	30	20457	10	6819	20	13638
25. San Leandro	48374	80.30	3.88	3.50	7.38	30	1848	30	1848	20	1232	40	2463	10	616
26. Oro Loma-Castro Valley	135457	90.10	12.20	.50	12.70	30	3179	30	3179	25	2649	40	4238	20	2119
27. Hayward	131249	102.00	13.39	7.20 l	20.59	30	5151	30	5151	20	3434	10	1717	10	1717
28, 29, 30, Union-Newark-Fremont	219576	78.50	17.24	2.30	19.54	30	4888	30	4888	30	4888	40	6517	20	3259
31. Livermore	63888	93.20	5.95	.30	6.25	30	1565	30	1565	30	1565	30	1565	20	1043
32. VCSD-Pleasanton	89183	90.00	8.03	1.40	9.43	30	2359	30	2359	30	2359	30	2359	20	1572
33. San Jose-Santa Clara	1041200	100.00	104.12	45.00 l	149.12	10	12437	10	12437	25	31092	20	24873	3	3731
34. Sunnyvale	99147	100.00	9.91	9.00 l	18.91	10	1577	10	1577	25	3944	20	3155	3	473
35. Palo Alto	190534	100.00	20.05 c	6.90	26.95	10	2248	10	2248	25	5620	10	2248	3	674
36. Menlo Park	58107	85.70	5.98 c	.60	6.58	10	549	8	439	30	1646	20	1098	10	549
37. Redwood City	87455	89.70	8.64 d	1.00	9.64	10	804	8	643	30	2413	20	1609	10	804
38. San Carlos-Belmont	51632	83.30	4.30	1.00	5.30	10	442	8	354	30	1326	20	884	10	442
39. Estero	28432	80.00	2.47 e	0.00	2.47	10	206	8	165	30	619	20	413	20	413
40. San Mateo	139089	100.00	15.61 f	0.00	15.61	10	1302	8	1041	30	3905	20	2604	20	2604
41. Burlingame	55776	100.00	5.58	.40	5.98	30	1496	30	1496	30	1496	10	499	20	997
42. Millbrae	21780	100.00	2.18	0.00	2.18	30	545	30	545	30	545	20	363	20	363
43. SSF-Airport-San Bruno	73264	92.00	8.24 h	1.30	9.54	30	2387	30	2387	20	1591	5	398	15	1193
44. Guadalupe Valley**	29456	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	26919	85.00	2.59 j	0.00	2.59	30	648	30	648	30	648	30	648	15	324
46. Pacifica	67055	85.00	5.70	0.00	5.70	30	1426	30	1426	30	1426	15	713	20	951
47. N. San Mateo	82903	94.00	7.79	0.00	7.79	30	1950	30	1950	30	1950	30	1950	20	1300
48. Southeast	142231	90.00t	18.25 u,p	4.20	22.45 i	30	5617	30	5617	30	5617	10	1872	20	3745
49. North Point	315029	163.00t	61.75 u	4.20	65.95 i	30	16501	30	16501	30	16501	10	5500	20	11000
50. Richmond-Sunset	194941	87.00t	18.36 u	1.20	19.56 i	30	4894	30	4894	30	4894	10	1631	20	3263
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	5436680		564	116	678		119242		119196		144660		90611		70026

Table 16. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment on 2000 - Base Case 1 without Compact Growth

Sewerage unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	13287	85.00	1.13	0.00	1.13	30	283	30	283	30	283	20	188	20	188
2. Sausalito	20504	90.00	1.85	0.00	1.85	30	462	30	462	30	462	20	308	20	308
3. Tiburon	9519	100.00	.95	0.00	.95	30	238	30	238	30	238	20	159	20	159
4. Mill Valley	19569	85.00	1.66	0.00	1.66	30	416	30	416	30	416	20	277	20	277
5. Ross Valley	62747	85.00	5.33	0.00	5.33	30	1334	30	1334	30	1334	20	890	20	890
6. San Rafael-San Quentin	35047	122.00	4.28	0.00	4.28	30	1070	30	1070	30	1070	20	713	20	713
7. Las Gallinas-Marin Bay	34761	80.00	2.78	0.00	2.78	30	696	30	696	30	696	20	464	20	464
8. Novato-Hamilton	86056	90.00	7.75	0.00	7.75	30	1938	30	1938	30	1938	20	1292	20	1292
9. Petaluma	71524	100.00	7.15	0.00	7.15	30	1790	30	1790	30	1790	20	1193	20	1193
10. Sonoma Valley	40974	100.00	4.10	0.00	4.10	30	1025	30	1025	30	1025	20	683	20	683
11. Napa-American Canyon	71137	100.00	7.11	.30	7.41	5	309	15	927	10	618	5	309	3	185
12. Vallejo-Mare Island	98908	100.00	9.89 a	.50	10.39a	30	2600	30	2600	30	2600	15	1300	20	1733
13. Benicia	26503	85.00	2.25	.60	2.85	30	714	30	714	30	714	10	238	15	357
14. Fairfield-Suisun-Travis	102148	100.00	12.21 a	3.70	15.91a	10	1327	10	1327	20	2655	20	2655	3	398
15. East County*	23263	85.00	1.98	0.00	1.98	30	495	30	495	20	330	10	165	15	247
16. Antioch	44666	80.00	3.57	.11	3.68	30	922	30	922	20	614	10	307	15	461
17. Pittsburg-Port Chicago	45523	85.00	3.87	1.27	5.14	30	1286	30	1286	20	857	10	429	15	643
18. Central CCCSD-Mt. View	430974	103.00 b	44.39	0.00	44.39	10	3702	10	3702	5	1851	1	370	3	1111
19. Crockett-Port Costa	4320	100.00	.43	0.00	.43	30	108	30	108	30	108	10	36	15	54
20. Rodeo	21430	100.00	2.14	0.00	2.14	30	536	30	536	20	357	10	179	10	179
21. Pinole-Hercules	34003	100.00	3.40	0.00	3.40	30	851	30	851	30	851	10	284	15	425
22. San Pablo	71522	100.00	7.15	.57	7.72	30	1932	30	1932	25	1610	15	966	15	966
23. Richmond	54685	100.00	5.47	2.00	7.47	30	1869	30	1869	25	1557	30	1869	15	934
24. EBMUD	663989	113.00	75.03	11.30	86.33	30	21600	30	21600	30	21600	10	7200	20	14400
25. San Leandro	54106	80.30	4.34	3.50	7.84	30	1963	30	1963	20	1308	40	2617	10	654
26. Oro Loma-Castro Valley	134613	90.10	12.13	.50	12.63	30	3160	30	3160	25	2633	40	4213	20	2106
27. Hayward	131176	102.00	13.38	7.20	20.58	30	5149	30	5149	20	3433	10	1716	10	1716
28, 29, 30, Union-Newark-Fremont	216620	78.50	17.00	2.30	19.30	30	4830	30	4830	30	4830	40	6440	20	3220
31. Livermore	62475	93.20	5.87	.30	6.17	30	1544	30	1544	30	1544	30	1544	20	1029
32. VCSD-Pleasanton	87963	90.00	7.92	1.40	9.32	30	2331	30	2331	30	2331	30	2331	20	1554
33. San Jose-Santa Clara	1068891	100.00	106.89	46.00	152.90	10	12751	10	12751	25	31877	20	25502	3	3825
34. Sunnyvale	95555	100.00	9.96	9.00	18.96	10	1581	10	1581	25	3952	20	3162	3	474
35. Palo Alto	200690	100.00	21.07 c	6.90	27.97	10	2333	10	2333	25	5832	10	2333	3	700
36. Menlo Park	58376	85.70	6.00 c	.60	6.60	10	551	8	441	30	1652	20	1101	10	551
37. Redwood City	85246	89.73	8.81 d	1.00	9.81	10	818	8	654	30	2453	20	1636	10	818
38. San Carlos-Belmont	52944	83.30	4.41	1.00	5.41	10	451	8	361	30	1354	20	902	10	451
39. Estero	28074	80.00	2.45 e	0.00	2.45	10	204	8	163	30	612	20	408	20	408
40. San Mateo	171038	100.00	18.89 f	0.00	18.89	10	1576	8	1261	30	4727	20	3151	20	3151
41. Burlingame	79738	100.00	7.97	.40	8.37	30	2095	30	2095	30	2095	10	698	20	1397
42. Millbrae	22805	106.00	2.38	0.00	2.38	30	596	30	596	30	596	20	397	20	397
43. SSF-Airport-San Bruno	73321	92.00	8.25 h	1.30	9.55	30	2388	30	2388	20	1592	5	398	15	1194
44. Guadalupe Valley**	25235	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	26533	85.00	2.56 j	0.00	2.56	30	639	30	639	30	639	30	639	15	320
46. Pacifica	69085	85.00	5.87	0.00	5.87	30	1469	30	1469	30	1469	15	735	20	980
47. N. San Mateo	87073	94.00	8.18	0.00	8.18	30	2048	30	2048	30	2048	30	2048	20	1365
48. Southeast	1410[illegible]	[illegible]	t 18.12	u,g 4.00	22.12 i	30	5535	30	5535	30	5535	10	1845	20	3690
49. North Point	330214	163.00	t 64.22	u 4.00	68.22 i	30	17070	30	17070	30	17070	10	5690	20	11380
50. Richmond-Sunset	193278	87.00	t 18.22	u 1.20	19.42 i	30	4858	30	4858	30	4858	10	1619	20	3238
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	5645642		551	111	702		123440		123338		150014		93599		72681

Table 17. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1980 - Base Case 2 without Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	10470	85.00	.89	0.00	.89	30	223	30	223	30	223	20	148	20	148
2. Sausalito	15039	90.00	1.35	0.00	1.35	30	339	30	339	30	339	20	226	20	226
3. Tiburon	7914	100.00	.79	0.00	.79	30	198	30	198	30	198	20	132	20	132
4. Mill Valley	17077	85.00	1.45	0.00	1.45	30	363	30	363	30	363	20	242	20	242
5. Ross Valley	53572	85.00	4.55	0.00	4.55	30	1139	30	1139	30	1139	20	760	20	760
6. San Rafael-San Quentin	33486	122.00	4.09	0.00	4.09	30	1022	30	1022	30	1022	20	681	20	681
7. Las Gallinas-Marin Bay	26736	80.00	2.14	0.00	2.14	30	535	30	535	30	535	20	357	20	357
8. Novato-Hamilton	45357	90.00	4.08	0.00	4.08	30	1021	30	1021	30	1021	20	681	20	681
9. Petaluma	36166	100.00	3.62	0.00	3.62	30	905	30	905	30	905	20	603	20	603
10. Sonoma Valley	20207	100.00	2.02	0.00	2.02	30	506	30	506	30	506	20	337	20	337
11. Napa-American Canyon	53385	100.00	5.34	.30	5.64	5	235	15	705	10	470	5	235	3	141
12. Vallejo-Mare Island	75909	100.00	7.59[a]	.50	8.09[a]	30	2024	30	2024	30	2024	15	1012	20	1350
13. Benicia	12037	85.00	1.02	.40	1.42	30	356	30	356	30	356	10	119	15	178
14. Fairfield-Suisun-Travis	61613	100.00	8.16[a]	3.20	11.36[a]	10	948	10	948	20	1895	20	1895	3	284
15. East County*	8058	85.00	.68	0.00	.68	30	171	30	171	20	114	10	57	15	86
16. Antioch	32908	80.00	2.63	.08	2.71	30	679	30	679	20	452	10	226	15	339
17. Pittsburg-Port Chicago	33198	85.00	2.82	.95	3.77	30	944	30	944	20	629	10	315	15	472
18. Central CCCSD-Mt. View	345358	103.00	[b] 35.57	0.00	35.57	10	2967	10	2967	5	1483	1	297	3	890
19. Crockett-Port Costa	3639	100.00	.36	0.00	.36	30	91	30	91	30	91	10	30	15	46
20. Rodeo	11533	100.00	1.15	0.00	1.15	30	289	30	289	20	192	10	96	10	96
21. Pinole-Hercules	20122	100.00	2.01	0.00	2.01	30	503	30	503	30	503	10	168	15	252
22. San Pablo	62531	100.00	6.25	.43	6.68	30	1672	30	1672	25	1393	15	836	15	836
23. Richmond	48503	100.00	4.85	1.81	6.66	30	1666	30	1666	25	1389	30	1666	15	833
24. EBMUD	562920	113.00	63.61	11.30[l]	74.91	30	18742	30	18742	30	18742	10	6247	20	12495
25. San Leandro	43378	80.30	3.48	3.50	6.98	30	1747	30	1747	20	1165	40	2330	10	582
26. Oro Loma-Castro Valley	133158	90.10	12.00	.50	12.50	30	3127	30	3127	25	2606	40	4169	20	2085
27. Hayward	111909	102.00	11.41	7.20[l]	18.61	30	4657	30	4657	20	3105	10	1552	10	1552
28, 29, 30. Union-Newark-Fremont	198522	78.50	15.58	2.30	17.88	30	4475	30	4475	30	4475	40	5966	20	2983
31. Livermore	46104	93.20	4.30	.30	4.60	30	1150	30	1150	30	1150	30	1150	20	767
32. VCSD-Pleasanton	68573	90.00	6.17	1.30	7.47	30	1869	30	1869	30	1869	30	1869	20	1246
33. San Jose-Santa Clara	927794	100.00	92.78	41.80[l]	134.58	10	11224	10	11224	25	28060	20	22448	3	3367
34. Sunnyvale	101918	100.00	10.19	7.50[l]	17.69	10	1475	10	1475	25	3689	20	2951	3	443
35. Palo Alto	175931	100.00	18.59[c]	6.90	25.49	10	2126	10	2126	25	5315	10	2126	3	638
36. Menlo Park	48220	85.70	5.13[c]	.60	5.73	10	478	8	382	30	1434	20	956	10	478
37. Redwood City	79197	89.70	7.90[d]	1.00	8.90	10	743	8	594	30	2228	20	1485	10	743
38. San Carlos-Belmont	50290	83.30	4.19	1.00	5.19	10	433	8	346	30	1298	20	866	10	433
39. Estero	26071	80.00	2.29[e]	0.00	2.29	10	191	8	153	30	572	20	381	20	381
40. San Mateo	96468	100.00	11.35[f]	0.00	11.35	10	946	8	757	30	2839	20	1893	20	1893
41. Burlingame	30300	100.00	3.03	.40	3.43	30	858	30	858	30	858	10	286	20	572
42. Millbrae	20353	100.00	2.04	0.00	2.04	30	509	30	509	30	509	20	339	20	339
43. SSF-Airport-San Bruno	76005	92.00	7.99[g]	1.30	9.29	30	2325	30	2325	20	1550	5	387	15	1162
44. Guadalupe Valley**	25016	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	14746	85.00	1.55[j]	0.00	1.55	30	389	30	389	30	389	30	389	15	[illegible]
46. Pacifica	48604	85.00	4.13	0.00	4.13	30	1034	30	1034	30	1034	15	517	[illegible]	[illegible]
47. N. San Mateo	76164	94.00	7.16	0.00	7.16	30	1791	30	1791	30	1791	30	1791	20	1194
48. Southeast	147861	90.00	[t] 13.36[u,m]	4.40	22.76[i]	30	5694	30	5694	30	5694	10	1898	20	3796
49. North Point	294008	163.00	[t] 58.32[u]	4.70	63.02[i]	30	15768	30	15768	30	15768	10	5256	20	10512
50. Richmond-Sunset	203689	87.00	[t] 19.12[u]	1.20	20.32[i]	30	5084	30	5084	30	5084	10	1695	20	[illegible]
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	4692785		494	105	599		105633		105545		128470		80069		61905

Table 18. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1985 - Base Case 2 without Compact Growth

Sewerage unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	10921	85.00	.93	0.00	.93	30	232	30	232	30	232	20	155	20	155
2. Sausalito	16001	90.00	1.44	0.00	1.44	30	360	30	360	30	360	20	240	20	240
3. Tiburon	9292	100.00	.93	0.00	.93	30	232	30	232	30	232	20	155	20	155
4. Mill Valley	16951	85.00	1.44	0.00	1.44	30	360	30	360	30	360	20	240	20	240
5. Ross Valley	55108	85.00	4.68	0.00	4.68	30	1172	30	1172	30	1172	20	781	20	781
6. San Rafael-San Quentin	34826	122.00	4.25	0.00	4.25	30	1063	30	1063	30	1063	20	709	20	709
7. Las Gallinas-Marin Bay	26783	80.00	2.14	0.00	2.14	30	536	30	536	30	536	20	357	20	357
8. Novato-Hamilton	49597	90.00	4.46	0.00	4.46	30	1117	30	1117	30	1117	20	745	20	745
9. Petaluma	41330	100.00	4.13	0.00	4.13	30	1034	30	1034	30	1034	20	689	20	689
10. Sonoma Valley	22659	100.00	2.27	0.00	2.27	30	567	30	567	30	567	20	378	20	378
11. Napa-American Canyon	53982	100.00	5.40	.30	5.70	5	238	15	713	10	475	5	238	3	143
12. Vallejo-Mare Island	78596	100.00	7.86[a]	.50	8.36[a]	30	2092	30	2092	30	2092	15	1046	20	1394
13. Benicia	15783	85.00	1.34	.50	1.84	30	461	30	461	30	461	10	154	15	230
14. Fairfield-Suisun-Travis	66744	100.00	8.67[a]	3.40	12.07[a]	10	1007	10	1007	20	2014	20	2014	3	302
15. East County*	8883	85.00	.76	0.00	.76	30	189	30	189	20	126	10	63	15	94
16. Antioch	33240	80.00	2.66	.09	2.75	30	688	30	688	20	459	10	229	15	344
17. Pittsburg-Port Chicago	33958	85.00	2.89	1.10	3.99	30	997	30	997	20	665	10	332	15	499
18. Central CCCSD-Mt. View	380015	103.00[b]	39.14	0.00	39.14	10	3264	10	3264	5	1632	1	326	3	979
19. Crockett-Port Costa	3579	100.00	.36	0.00	.36	30	90	30	90	30	90	10	30	15	45
20. Rodeo	15704	100.00	1.57	0.00	1.57	30	393	30	393	20	262	10	131	10	131
21. Pinole-Hercules	26346	100.00	2.63	0.00	2.63	30	659	30	659	30	659	10	220	15	330
22. San Pablo	68125	100.00	6.81	.48	7.29	30	1825	30	1825	25	1520	15	912	15	912
23. Richmond	46323	100.00	4.63	1.86	6.49	30	1624	30	1624	25	1354	30	1624	15	812
24. EBMUD	544352	113.00	61.51	11.30[l]	72.81	30	18218	30	18218	30	18218	10	6073	20	12145
25. San Leandro	41507	80.30	3.33	3.50	6.83	30	1710	30	1710	20	1140	40	2279	10	570
26. Oro Loma-Castro Valley	135111	90.10	12.17	.50	12.67	30	3171	30	3171	25	2642	40	4228	20	2114
27. Hayward	122421	102.00	12.49	7.20[l]	19.69	30	4926	30	4926	20	3284	10	1642	10	1642
28, 29,30. Union-Newark-Fremont	216400	78.50	16.99	2.30	19.29	30	4826	30	4826	30	4826	40	6434	20	3217
31. Livermore	51327	93.20	4.78	.30	5.08	30	1272	30	1272	30	1272	30	1272	20	848
32. VCSD-Pleasanton	84105	90.00	7.57	1.30	8.87	30	2219	30	2219	30	2219	30	2219	20	1479
33. San Jose-Santa Clara	967094	100.00	96.71	42.90[l]	139.61	10	11643	10	11643	25	29109	20	23287	3	3493
34. Sunnyvale	96955	100.00	9.70	9.00[l]	18.70	10	1559	10	1559	25	3898	20	3118	3	468
35. Palo Alto	175445	100.00	18.54[c]	6.90	25.44	10	2122	10	2122	25	5305	10	2122	3	637
36. Menlo Park	46516	85.70	4.99[c]	.60	5.59	10	466	8	373	30	1398	20	932	10	466
37. Redwood City	80369	89.70	8.01[d]	1.00	9.01	10	751	8	601	30	2254	20	1503	10	751
38. San Carlos-Belmont	49446	83.30	4.12[e]	1.00	5.12	10	427	8	342	30	1281	20	854	10	427
39. Estero	28083	80.00	2.45	0.00	2.45	10	204	8	163	30	612	20	408	20	408
40. San Mateo	105126	100.00	12.21[f]	0.00	12.21	10	1019	8	815	30	3056	20	2037	20	2037
41. Burlingame	29099	100.00	2.91	.40	3.31	30	828	30	828	30	828	10	276	20	552
42. Millbrae	19411	100.00	1.94	0.00	1.94	30	486	30	486	30	486	20	324	20	324
43. SSF-Airport-San Bruno	72104	92.00	7.63[g]	1.30	8.93	30	2235	30	2235	20	1490	5	373	15	1118
44. Guadalupe Valley**	24139	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	28918	85.00	2.76[j]	0.00	2.76	30	690	30	690	30	690	30	690	15	345
46. Pacifica	59524	85.00	5.06	0.00	5.06	30	1266	30	1266	30	1266	15	633	20	844
47. N. San Mateo	72997	94.00	6.86	0.00	6.86	30	1717	30	1717	30	1717	30	1717	20	1145
48. Southeast	140225	90.00[t]	17.59[u,h]	4.30	21.89[i]	30	5478	30	5478	30	5478	10	1826	20	3652
49. North Point	287772	163.00[t]	57.31[u]	4.50	61.81[i]	30	15464	30	15464	30	15464	10	5155	20	10309
50. Richmond-Sunset	194746	87.00[t]	18.34[u]	1.20	19.54[i]	30	4890	30	4890	30	4890	10	1630	20	3260
TOTALS (S.U. 1-50, SEWERED POP. ONLY)[r]	4836457		507	108	615		107786		107688		131303		82800		62915

Table 19. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1990 - Base Case 2 without Compact Growth

Sewerage unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	12817	85.00	1.09	0.00	1.09	30	273	30	273	30	273	20	182	20	182
2. Sausalito	16562	90.00	1.49	0.00	1.49	30	373	30	373	30	373	20	249	20	249
3. Tiburon	9473	100.00	.95	0.00	.95	30	237	30	237	30	237	20	158	20	158
4. Mill Valley	17819	85.00	1.51	0.00	1.51	30	379	30	379	30	379	20	253	20	253
5. Ross Valley	56336	85.00	4.79	0.00	4.79	30	1198	30	1198	30	1198	20	799	20	799
6. San Rafael-San Quentin	33691	122.00	4.11	0.00	4.11	30	1028	30	1028	30	1028	20	686	20	686
7. Las Gallinas-Marin Bay	33238	80.00	2.66	0.00	2.66	30	665	30	665	30	665	20	444	20	444
8. Novato-Hamilton	68432	90.00	6.16	0.00	6.16	30	1541	30	1541	30	1541	20	1027	20	1027
9. Petaluma	67308	100.00	6.73	0.00	6.73	30	1684	30	1684	30	1684	20	1123	20	1123
10. Sonoma Valley	27071	100.00	2.71	0.00	2.71	30	677	30	677	30	677	20	452	20	452
11. Napa American Canyon	55230	100.00	5.52	.30	5.82	5	243	15	728	10	486	5	243	3	146
12. Vallejo-Mare Island	88851	100.00	8.89[a]	.50	9.39[a]	30	2348	30	2348	30	2348	15	1174	20	[illegible]
13. Benicia	23936	85.00	2.03	.50	2.53	30	634	30	634	30	634	10	211	15	[illegible]
14. Fairfield-Suisun-Travis	80605	100.00	10.06[a]	3.50	13.56[a]	10	1131	10	1131	20	2262	20	2262	3	[illegible]
15. East County*	26133	85.00	2.22	0.00	2.22	30	556	30	556	20	371	10	185	15	278
16. Antioch	43511	80.00	3.48	.10	3.58	30	896	30	896	20	597	10	299	15	448
17. Pittsburg-Port Chicago	43664	85.00	3.71	1.16	4.87	30	1219	30	1219	20	813	10	406	15	[illegible]
18. Central CCCSD-Mt. View	403064	103.00[b]	41.52	0.00	41.52	10	3462	10	3462	5	1731	1	346	3	[illegible]
19. Crockett-Port Costa	4121	100.00	.41	0.00	.41	30	103	30	103	30	103	10	34	15	52
20. Rodeo	16593	100.00	1.66	0.00	1.66	30	415	30	415	20	277	10	138	10	138
21. Pinole-Hercules	27431	100.00	2.74	0.00	2.74	30	686	30	686	30	686	10	229	15	343
22. San Pablo	66541	100.00	6.65	.50	7.15	30	1790	30	1790	25	1492	15	895	15	895
23. Richmond	45350	100.00	4.53	1.90	6.43	30	1610	30	1610	25	1342	30	1610	15	805
24. EBMUD	531064	113.00	60.01	11.30[l]	71.31	30	17842	30	17842	30	17842	10	5947	20	11895
25. San Leandro	39955	80.30	3.21	3.50	6.71	30	1678	30	1678	20	1119	40	2238	10	559
26. Oro Loma-Castro Valley	130884	90.10	11.79	.50	12.29	30	3076	30	3076	25	2563	40	4101	20	2050
27. Hayward	126238	102.00	12.88	7.20[l]	20.08	30	5023	30	5023	20	3349	10	1674	10	1674
28, 29,30.Union-Newark-Fremont	206334	78.50	16.20	2.30	18.50	30	4628	30	4628	30	4628	40	6171	20	3085
31. Livermore	59204	93.20	5.52	.30	5.82	30	1456	30	1456	30	1456	30	1456	20	970
32. VCSD-Pleasanton	86874	90.00	7.82	1.30	9.12	30	2281	30	2281	30	2281	30	2281	20	1521
33. San Jose-Santa Clara	940332	100.00	94.03	43.90[l]	137.93	10	11504	10	11504	25	28759	20	23007	3	3451
34. Sunnyvale	93158	100.00	9.32	9.00[l]	18.32	10	1528	10	1528	25	3819	20	3055	3	458
35. Palo Alto	171388	100.00	18.14[c]	6.90	25.04	10	2088	10	2088	25	5221	10	2088	3	626
36. Menlo Park	51749	85.70	5.43[c]	.60	6.03	10	503	8	403	30	1510	20	1007	10	503
37. Redwood City	80586	89.70	8.03[d]	1.00	9.03	10	753	8	602	30	2259	20	1506	10	753
38. San Carlos-Belmont	47864	83.30	3.99	1.00	4.99	10	416	8	333	30	1248	20	832	10	416
39. Estero	26885	80.00	2.35[e]	0.00	2.35	10	196	8	157	30	588	20	392	20	392
40. San Mateo	100983	100.00	11.80[f]	0.00	11.80	10	984	8	787	30	2952	20	1968	20	1968
41. Burlingame	27999	100.00	2.80	.40	3.20	30	801	30	801	30	801	10	267	20	534
42. Millbrae	18716	100.00	1.87	0.00	1.87	30	468	30	468	30	468	20	312	20	312
43. SSF-Airport-San Bruno	69221	92.00	7.37[g]	1.30	8.67	30	2169	30	2169	20	1446	5	361	15	1084
44. Guadalupe Valley**	27811	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	27455	85.00	2.63[j]	0.00	2.63	30	659	30	659	30	659	30	659	15	329
46. Pacifica	59340	85.00	5.04	0.00	5.04	30	1262	30	1262	30	1262	15	631	[illegible]	841
47. N. San Mateo	70231	94.00	6.60	0.00	6.60	30	1652	30	1652	30	1652	30	1652	20	1101
48. Southeast	134599	90.00[t]	17.42[u,o]	4.20	21.62[i]	30	5409	30	5409	30	5409	10	1803	20	3606
49. North Point	284228	163.00[t]	56.73[u]	4.30	61.03[i]	30	15269	30	15269	30	15269	10	5090	20	10180
50. Richmond-Sunset	188130	87.00[t]	17.77[u]	1.20	18.97[i]	30	4746	30	4746	30	4746	10	1582	[illegible]	[illegible]
TOTALS (S.U. 1-50.SEWERED POP. ONLY)[r]	4922652		514	109	623		109539		109454		132501		83484		63820

Table 20. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 1995 - Base Case 2 without Compact Growth

Sewerage unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	12505	85.00	1.06	0.00	1.06	30	266	30	266	30	266	20	177	20	177
2. Sausalito	17609	90.00	1.58	0.00	1.58	30	397	30	397	30	397	20	264	20	264
3. Tiburon	9220	100.00	.92	0.00	.92	30	231	30	231	30	231	20	154	20	154
4. Mill Valley	18060	85.00	1.54	0.00	1.54	30	384	30	384	30	384	20	256	20	256
5. Ross Valley	61384	85.00	5.22	0.00	5.22	30	1305	30	1305	30	1305	20	870	20	870
6. San Rafael-San Quentin	33490	122.00	4.09	0.00	4.09	30	1022	30	1022	30	1022	20	682	20	682
7. Las Gallinas-Marin Bay	33070	80.00	2.65	0.00	2.65	30	662	30	662	30	662	20	441	20	441
8. Novato-Hamilton	88518	90.00	7.97	0.00	7.97	30	1993	30	1993	30	1993	20	1329	20	1329
9. Petaluma	66972	100.00	6.70	0.00	6.70	30	1676	30	1676	30	1676	20	1117	20	1117
10. Sonoma Valley	31083	100.00	3.11	0.00	3.11	30	778	30	778	30	778	20	518	20	518
11. Napa-American Canyon	59104	100.00	5.91	.30	6.21	5	259	15	777	10	518	5	259	3	155
12. Vallejo-Mare Island	91488	100.00	9.15 [a]	.50	9.65[a]	30	2414	30	2414	30	2414	15	1207	20	1609
13. Benicia	23530	85.00	2.00	.60	2.60	30	651	30	651	30	651	10	217	15	325
14. Fairfield-Suisun-Travis	92106	100.00	11.21 [a]	3.60	14.81[a]	10	1235	10	1235	20	2470	20	2470	3	371
15. East County*	39948	85.00	3.40	0.00	3.40	30	850	30	850	20	566	10	283	15	425
16. Antioch	43011	80.00	3.44	.11	3.55	30	888	30	888	20	592	10	296	15	444
17. Pittsburg-Port Chicago	43395	85.00	3.69	1.23	4.92	30	1231	30	1231	20	820	10	410	15	615
18. Central CCCSD-Mt. View	401442	103.00[b]	41.35	0.00	41.35	10	3448	10	3448	5	1724	1	345	3	103[illegible]
19. Crockett-Port Costa	4009	100.00	.40	0.00	.40	30	100	30	100	30	100	10	33	15	50
20. Rodeo	19106	100.00	1.91	0.00	1.91	30	478	30	478	20	319	10	159	10	159
21. Pinole-Hercules	28598	100.00	2.86	0.00	2.86	30	716	30	716	30	716	10	239	15	358
22. San Pablo	67593	100.00	6.76	.52	7.28	30	1821	30	1821	25	1518	15	911	15	911
23. Richmond	47190	100.00	4.72	1.95	6.67	30	1669	30	1669	25	1390	30	1669	15	834
24. EBMUD	538018	113.00	60.80	11.30[l]	72.10	30	18038	30	18038	30	18038	10	6013	20	12026
25. San Leandro	40344	80.30	3.24	3.50	6.74	30	1686	30	1686	20	1124	40	2248	10	562
26. Oro Loma-Castro Valley	128256	90.10	11.56	.50	12.06	30	3016	30	3016	25	2514	40	4022	20	2011
27. Hayward	123519	102.00	12.60	7.20[l]	19.80	30	4954	30	4954	20	3302	10	1651	10	1651
28, 29,30.Union-Newark-Fremont	201265	78.50	15.80	2.30	18.10	30	4528	30	4528	30	4529	40	6038	20	3019
31. Livermore	59145	93.20	5.51	.30	5.81	30	1454	30	1454	30	1454	30	1454	20	969
32. VCSD-Pleasanton	84545	90.00	7.61	1.40	9.01	30	2254	30	2254	30	2254	30	2254	20	1503
33. San Jose-Santa Clara	934448	100.00	93.44	45.00[l]	138.44	10	11546	10	11546	25	28866	20	23093	3	3464
34. Sunnyvale	91488	100.00	9.15	9.00[l]	18.15	10	1514	10	1514	25	3784	20	3027	3	454
35. Palo Alto	170886	100.00	18.09 [c]	6.90	24.99	10	2084	10	2084	25	5210	10	2084	3	625
36. Menlo Park	53418	85.70	5.58 [c]	.60	6.18	10	515	8	412	30	1546	20	1030	10	515
37. Redwood City	79533	89.70	7.93 [d]	1.00	8.93	10	745	8	596	30	2235	20	1490	10	745
38. San Carlos-Belmont	47312	83.30	3.94	1.00	4.94	10	412	8	330	30	1236	20	824	10	412
39. Estero	26281	80.00	2.30 [e]	0.00	2.30	10	192	8	154	30	576	20	384	20	384
40. San Mateo	106233	100.00	12.32 [f]	0.00	12.32	10	1028	8	822	30	3083	20	2056	20	2056
41. Burlingame	33194	100.00	3.32	.40	3.72	30	931	30	931	30	931	10	310	20	620
42. Millbrae	18849	100.00	1.88	0.00	1.88	30	472	30	472	30	472	20	314	20	314
43. SSF-Airport-San Bruno	68057	92.00	7.76 [h]	1.30	9.06	30	2267	30	2267	20	1511	5	378	15	1134
44. Guadalupe Valley**	27202	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	26680	85.00	2.57 [j]	0.00	2.57	30	642	30	642	30	642	30	642	15	321
46. Pacifica	57763	85.00	4.91	0.00	4.91	30	1228	30	1228	30	1228	15	614	20	819
47. N. San Mateo	70696	94.00	6.65	0.00	6.65	30	1663	30	1663	30	1663	30	1663	20	1108
48. Southeast	131940	90.00[t]	17.12 [u,p]	4.20	21.32[i]	30	5335	30	5335	30	5335	10	1778	20	3557
49. North Point	290743	163.00[t]	57.79 [u]	4.20	61.99[i]	30	15510	30	15510	30	15510	10	5170	20	10340
50. Richmond-Sunset	184799	87.00[t]	17.48 [u]	1.20	18.68[i]	30	4673	30	4673	30	4673	10	1558	20	3115
TOTALS (S.U. 1-50.SEWERED POP. ONLY)[r]	4980646		521	110	631		111162		111101		134230		84404		64826

Table 21. Estimated Municipal and Non-Discrete Industrial Wastewater Loads After Treatment in 2000 - Base Case 2 without Compact Growth

Sewerage Unit	Population served	Domestic Flow[s] gpcd	Domestic Flow[s] mgd	Ind. Flow mgd	ADWF mgd	BOD5 mg/l	BOD5 ppd	TSS mg/l	TSS ppd	TN mg/l	TN ppd	TP mg/l	TP ppd	N-NH3 mg/l	N-NH3 ppd
1. Richardson Bay	12314	85.00	1.05	0.00	1.05	30	262	30	262	30	262	20	175	20	175
2. Sausalito	17659	90.00	1.59	0.00	1.59	30	398	30	398	30	398	20	265	20	265
3. Tiburon	9065	100.00	.91	0.00	.91	30	227	30	227	30	227	20	151	20	151
4. Mill Valley	17927	85.00	1.52	0.00	1.52	30	381	30	381	30	381	20	254	20	254
5. Ross Valley	60858	85.00	5.17	0.00	5.17	30	1294	30	1294	30	1294	20	863	20	863
6. San Rafael-San Quentin	33170	122.00	4.05	0.00	4.05	30	1012	30	1012	30	1012	20	675	20	675
7. Las Gallinas-Marin Bay	32533	80.00	2.60	0.00	2.60	30	651	30	651	30	651	20	434	20	434
8. Novato-Hamilton	86630	90.00	7.80	0.00	7.80	30	1951	30	1951	30	1951	20	1300	20	1300
9. Petaluma	67460	100.00	6.75	0.00	6.75	30	1688	30	1688	30	1688	20	1125	20	1125
10. Sonoma Valley	34985	100.00	3.50	0.00	3.50	30	875	30	875	30	875	20	584	20	584
11. Napa-American Canyon	63002	100.00	6.30	.30	6.60	5	275	15	826	10	550	5	275	3	[illegible]
12. Vallejo-Mare Island	91224	100.00	9.12 [a]	.50	9.62a	30	2408	30	2408	30	2408	15	1204	20	[illegible]
13. Benicia	23081	85.00	1.96	.60	2.56	30	641	30	641	30	641	10	214	15	[illegible]
14. Fairfield-Suisun-Travis	93499	100.00	11.35 [a]	3.70	15.05a	10	1255	10	1255	20	2510	20	2510	3	377
15. East County*	43053	85.00	3.66	0.00	3.66	30	916	30	916	20	610	10	305	15	458
16. Antioch	42957	80.00	3.44	.11	3.55	30	887	30	887	20	592	10	296	15	444
17. Pittsburg-Port Chicago	42796	85.00	3.64	1.27	4.91	30	1228	30	1228	20	819	10	[illegible]	15	[illegible]
18. Central CCCSD-Mt. View	395340	103.00[b]	40.72	0.00	40.72	10	3396	10	3396	5	1698	1	340	3	[illegible]
19. Crockett- Port Costa	3939	100.00	.39	0.00	.39	30	99	30	99	30	99	10	33	15	[illegible]
20. Rodeo	19079	100.00	1.91	0.00	1.91	30	477	30	477	20	318	10	159	10	159
21. Pinole-Hercules	28893	100.00	2.89	0.00	2.89	30	723	30	723	30	723	10	241	15	361
22. San Pablo	66688	100.00	6.67	.57	7.24	30	1811	30	1811	25	1509	15	906	15	906
23. Richmond	47438	100.00	4.74	2.00	6.74	30	1687	30	1687	25	1406	30	1687	15	844
24. EBMUD	546542	113.00	61.76	11.30[l]	73.06	30	18279	30	18279	30	18279	10	6093	20	12186
25. San Leandro	41684	80.30	3.35	3.50	6.85	30	1713	30	1713	20	1142	40	2284	10	571
26. Oro Loma-Castro Valley	126786	90.10	11.42	.50	11.92	30	2983	30	2983	25	2486	40	3978	20	1989
27. Hayward	122148	102.00	12.46	7.20[l]	19.66	30	4919	30	4919	20	3279	10	1640	10	1640
28, 29,30,Union-Newark-Fremont	198143	78.50	15.55	2.30	17.85	30	4467	30	4467	30	4467	40	5956	20	2978
31. Livermore	58130	93.20	5.42	.30	5.72	30	1431	30	1431	30	1431	30	1431	20	[illegible]
32. VCSD-Pleasanton	83121	90.00	7.48	1.40	8.88	30	2222	30	2222	30	2222	30	2222	20	1481
33. San Jose-Santa Clara	930769	100.00	93.08	46.00[l]	139.08	10	11599	10	11599	25	28998	20	23198	3	3480
34. Sunnyvale	90738	100.00	9.07	9.00[l]	18.07	10	1507	10	1507	25	3768	20	3015	3	452
35. Palo Alto	173454	100.00	18.35 [c]	6.90	25.25	10	2105	10	2105	25	5264	10	2105	3	632
36. Menlo Park	54505	85.70	5.67 [c]	.60	6.27	10	523	8	418	30	1569	20	1046	10	523
37. Redwood City	79377	89.70	7.92 [d]	1.00	8.92	10	744	8	595	30	2232	20	1488	10	744
38. San Carlos-Belmont	47272	83.30	3.94	1.00	4.94	10	412	8	329	30	1235	20	824	10	412
39. Estero	25907	80.00	2.27 [e]	0.00	2.27	10	190	8	152	30	569	20	379	20	379
40. San Mateo	116013	100.00	13.30 [f]	0.00	13.30	10	1109	8	887	30	3328	20	2219	20	2219
41. Burlingame	41438	100.00	4.14	.40	4.54	30	1137	30	1137	30	1137	10	379	20	758
42. Millbrae	19339	100.00	1.93	0.00	1.93	30	484	30	484	30	484	20	323	20	323
43. SSF-Airport-San Bruno	67576	92.00	7.72[h]	1.30	9.02	30	2256	30	2256	20	1504	5	376	15	1128
44. Guadalupe Valley**	26874	90.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
45. Montara-Granada-Half Moon Bay	26206	85.00	2.53[j]	0.00	2.53	30	632	30	632	30	632	30	632	15	316
46. Pacifica	56785	85.00	4.83	0.00	4.83	30	1208	30	1208	30	1208	15	604	20	805
47. N. San Mateo	72524	94.00	6.82	0.00	6.82	30	1706	30	1706	30	1706	30	1706	20	1137
48. Southeast	130569	90.00 [t]	16.97[u,q]	4.00	20.97[i]	30	5247	30	5247	30	5247	10	1749	20	3498
49. North Point	299817	163.00 [t]	59.27[u]	4.00	63.27[i]	30	15830	30	15830	30	15830	10	5277	20	10553
50. Richmond-Sunset	182840	87.00 [t]	17.31[u]	1.20	18.51[i]	30	4630	30	4630	30	4630	10	1543	20	3087
TOTALS (S.U. 1-50.SEWERED POP. ONLY)[r]	5000150		524	111	635		111876		111831		135269		84870		65391

FOOTNOTES FOR TABLES 1 to 21

[a]The flow of S.U. 12 includes 0.6 mgd. from Mare Island; the flow of S.U. 14 includes 2.0 mgd from Travis Air Force Base.

[b]Including non-discrete industrial flow.

[c]Including dry weather infiltration flow of 1.0 mgd.

[d]Including dry weather infiltration of 0.8 mgd.

[e]Including dry weather infiltration of 0.2 mgd.

[f]Including dry weather infiltration of 1.7 mgd.

[g]Including 1.0 mgd. from S.F. Airport.

[h]Including 1.5 mgd from S.F. Airport.

[i]Including flows from employed residents and commuters, tourists, and dry weather infiltration.

[j]Including 0.3 mgd. from recreation activities.

[k]Including 2.0 mgd. from Guadalupe Valley.

[l]Including flow from canneries.

[m]Including 2.4 mgd. from Guadalupe Valley.

[n]Including 2.5 mgd. from Guadalupe Valley.

[o]Including 3.0 mgd. from Guadalupe Valley.

[p]Including 3.1 mgd. from Guadalupe Valley.

[q]Including 3.2 mgd. from Guadalupe Valley.

[r]Totals do not include waste loads from Sewerage Units 51-59.

[s]Including dry weather infiltration flow.

[t]Including flows from tourists as well as employed residents and commuters.

[u]Including dry weather infiltration of 2.8, 10.4, and 1.4 mgd. for S.U. 48, 49, and 50 respectively.

*Brentwood, Byron, Discovery Bay, Oakley and Bethel Island.

**Tributary to San Francisco Southeast Plant.

WQ/Tech #31
Davis/Bursztynsky

WATER QUALITY MANAGEMENT PLAN

PROPOSED STRATEGY FOR PRETREATMENT

OF INDUSTRIAL WASTES DISCHARGED TO

MUNICIPAL SEWER SYSTEMS

Technical Memorandum No. 31
March, 1977

INTRODUCTION

The purpose of this memorandum is to describe in some detail a proposed strategy for pretreatment of industrial wastes discharged to municipal sewer systems. Actions necessary to implement the strategy are recommended in the draft Environmental Management Plan. Two other technical memoranda and an issue paper dealt with different aspects of industrial pretreatment. They are:

Technical Memorandum No. 2: Review of existing laws, policies and requirements for the pretreatment or treatment of industrial wastes, October 12, 1976

Issue Paper No. 1: Pretreatment of industrial wastes discharged to municipal sewer systems, January 14, 1977

Technical Memorandum No. 26: Estimated costs of treating industrial discharges, October 4, 1977

Some of the material contained in these earlier memoranda is summarized here to illustrate the rationale for the proposed strategy. The purpose of industrial pretreatment is to prevent the discharge to the sewer of materials that:

- adversely affect the performance of the municipal treatment plant
- pass through the municipal treatment plant and into the environment unaltered
- adversely affect the reuse potential of municipal sewage sludge.

The principal materials of concern are toxic substances and particularly heavy metals.

The general approach used in developing a pretreatment strategy was to regard industrial pretreatment as one element in a more comprehensive program for control of toxic materials. Consequently the discussion of pretreatment is prefaced by a general discussion of toxic materials.

TOXIC MATERIALS AND THEIR CONTROL

As part of the EMP program a special study on toxic materials in San Francisco Bay and estuary was prepared by the Bodega Bay Institute of Pollution Ecology. The study noted that surprisingly few pollutant effects on organisms in San Francisco Bay have been observed. However this may only be true because few detailed biological studies have been conducted. Certain adverse effects on individual birds and animals have been recorded but populations have not been affected. The Dungeness crab is in decline and fish kills still occur for unknown reasons.

Heavy metals, petroleum compounds and synthetic organic compounds are among the most significant environmental toxicants. High levels of certain metals exist in certain parts of the bay. A presently incomcomplete study conducted by Lawrence Berkeley Laboratory indicates the concentrations of certain metals in bay waters approach those that have been shown to harm native organisms in the laboratory. Levels of polychlorinated biphenyls in bay waters are equivalent to the maximum permissible concentration proposed by EPA as a standard for receiving waters.

Sources

Toxic materials, emanate from a wide variety of sources. Table 1 shows the estimated emissions of heavy metals to the waters of the region in 1975 and 2000. Emissions are expressed in terms of equivalent toxic metals, a summation of metals loads weighted in proportion to their toxicity to aquatic life. An explanation of the calculation method is contained in Technical Memorandum No. 7: Equivalent Heavy Metals Loading Factors.

It is apparent from the table that delta-outflow is the largest contributor of toxic metals to the waters of the region. The second largest contributor is surface runoff. Unlike delta outflow the surface runoff load is expected to increase with time. Municipal and industrial point sources and aerial fallout together contribute less than 15 percent of the total load.

It is difficult to determine what proportion of the metals contained in the municipal discharges is attributable to indirect industrial discharges. It is possible, however, to make a rough estimate by comparing the quality of municipal discharges known to include industrial wastewaters with those known not to. In this way it was estimated that a little less than half the metals load contained in the regional municipal total is attributable to industry. Thus in the year 2000, assuming the 1975 level of pretreatment implementation, about 3 percent of the metals discharged to the waters of the region originate from industrial discharges to municipal sewer systems.

TABLE 1

Equivalent Toxic Metals Discharged to the Region

Source	1975 million lb/yr	1975 % of total	2000 million lb/yr	2000 % of total
Municipal (including indirect industrial)	1.35	11	0.78	7
Direct industrial	0.12	1	0.13	1
Surface runoff	3.79	31	4.83	44
Delta outflow	6.45	53	5.00	45
Aerial fallout	0.53	4	0.26	2
Total	12.24		11.00	

Feasibility, Cost and Effectiveness of Controls

The feasibility, cost and effectiveness of controlling metals from each of the sources varies considerably. Controlling the metals content of delta outflow is virtually impossible. Metals occur in river water at extremely low concentrations. The estimated decrease in metals contribution from the delta is attributable to the expected decrease in flow. Aerial fallout can be reduced but at great expense. The projected reduction in metals contribution from this source is an incidental benefit of meeting the public health-based air quality standards. Control of the other three sources, municipal discharges, industrial discharges and surface runoff is relatively more feasible.

As noted earlier, a little less than half the metals contained in municipal discharges is thought to originate from industrial sources. The remaining metals are contained in domestic wastewaters and come from very diffuse sources such as corrosion of plumbing fixtures and photographic processing in homes. It is almost impossible to control these domestic metals at their source. The industrial metals contribution can be controlled at source more readily. Although it is extremely difficult to estimate the cost of industrial pretreatment an attempt was made as part of this planning program. The cost of increasing the treatment of indirect industrial discharges to a level comparable with that required for direct discharges to the environment is thought to be about $15 million per annum. The reduction in metals discharged to the receiving waters would be 1 to 2 percent of the total.

The quantity of metals emitted by direct industrial dischargers could be reduced by increasing treatment levels still further. No attempt was made to estimate the cost of doing this. Regardless of cost, however, the effectiveness of the action is limited by the fact that metals from direct industrial discharges represent only 1 percent of the total. Additional treatment might result in a reduction of 0.5 percent in total metals emissions.

Metals input to the receiving waters can also be reduced by further treatment of the entire municipal waste stream; that is the mix of domestic and indirect industrial wastes. The projected drop in metals input from this source between 1975 and 2000 shown in Table 1 is attributable to removals obtained by increasing the treatment levels of several major discharges from primary to secondary. Additional removals could be obtained by increasing treatment levels still further. The most likely treatment process to be employed would be chemical precipitation at an elevated pH. Approximately 2 to 3 percent of the regional metals input to receiving waters might be removed in this way. The estimated cost of building and operating the additional treatment at all municipal treatment facilities that receive a significant quantity of industrial waste is $50 million per annum. Thus the unit cost of removing metals from the entire municipal waste stream appears to be considerably higher than treating individual indirect industrial discharges.

Surface runoff controls can reduce the availability of toxic materials for flushing into waterways during rainstorms. There is little or no definitive data on the effectiveness of surface runoff controls but the following estimates illustrate their potential for reducing the total regional metals input to receiving waters. Data gathered during the surface runoff program suggests the concentrations of equivalent toxic metals in runoff from urban areas is 5 to 6 times greater than that from non-urban or undeveloped areas. Thus about 4 million lbs/yr of the 4.83 million lbs/yr of metals contained in surface runoff is estimated to be contained in runoff from urban areas. If we assume that half of this quantity is transportation related and represents materials accumulating on streets, highways and parking lots that are not removed by present street cleaning practices then this is the amount that might be subject to new controls such as improved street sweeping. It seems reasonable to expect that inexpensive and fairly minor changes in street cleaning practices that improve the pick up of fine material could reduce metals loads from this source by 25 percent or 0.5 million lb/yr. This represents 5 percent of the regional total. Although there are a number of assumptions involved it is clear that surface runoff controls have a considerable potential for reducing the total regional metals input to receiving waters.

In conclusion it appears that surface runoff controls and to a lesser degree pretreatment of industrial discharges to municipal sewer systems are the most cost-effective ways to reduce the flow of metals to receiving waters.

Toxicant Control Strategy

In general it is apparent that we lack the information necessary to develop a comprehensive toxic materials control strategy. We do not know whether toxic materials are seriously affecting the bay. Our estimates of the relative contributions of toxicants from different sources are imprecise. The effectiveness of some control measures is largely speculative. In the face of such uncertainty it appears that the most prudent strategy is to establish a program to gather the necessary information while taking only low-cost actions to minimize the discharge of toxic materials to the waters of the region. How this strategy relates to industrial pretreatment is discussed in the following sections.

It should be noted that this toxicant control strategy must be regarded as a preliminary approach that will have to be reviewed and refined in the future as more information accumulates.

REGULATION OF TOXIC MATERIALS CONTAINED IN WASTE DISCHARGES

The Water Quality Control Plan for oceans waters of California, known as the Ocean Plan, specifies limits on concentrations of toxic materials that may be discharged to the ocean. The limits were based on what was known in 1972 about the effects of toxic materials on ocean waters and marine life. The limits are written into the discharge permits for municipalities and industries that discharge wastewater to the ocean. No comparable limits for discharge to San Francisco Bay have been developed based on current knowledge of the effects of toxic materials on estuarine life. In the absence of such standards the San Francisco Bay Regional Water Quality Control Board took the common sense, although rather arbitrary approach, that the discharge of toxic materials to the Bay should be controlled to the same degree as discharges to the ocean. Thus the Ocean Plan toxic materials limits are written into the permits for discharge the Bay as well as to the ocean.

The Regional Board will allow variances in the prescribed limits if the discharge demonstrates that:

- the discharger has a good source control ordinance
- the individual sources of at least eighty percent of the metals are known, and
- reasonable efforts are being made to pretreat industrial discharges if they are the cause of the violation.

The issuing of variances is at the discretion of the Regional Board.

Because the Ocean Plan forms the basis for local toxic limits and because it was recently amended a short discussion of the relevant parts of the plan follows.

The Ocean Plan and It's Amendments

As noted earlier the limitations on discharge of toxic metals included in the Ocean Plan were based on what was known in 1972, the date of the plan's publication, about the effect of toxic materials on marine life. The limits did not allow any credit for the dilution obtained as a result of discharge into deep water; they applied directly to the treatment plant effluent.

On January 19, 1978, the State Water Resources Control Board adopted amendments to the Ocean Plan. Revised toxic materials limits are included in the amended plan based on more recent research into the effects of various materials on marine life. Significantly, however, the new limits apply to the discharge after initial dilution has occurred. For this reason the original and amended standards shown in Table 2 are not directly comparable.

TABLE 2: TOXIC MATERIALS LIMITATIONS OF THE WATER QUALITY CONTROL PLAN FOR OCEAN WATERS OF CALIFORNIA

	1972 Ocean Plan Limits, mg/l		Amendments Limits, mg/l
	Concentration not to be exceeded more than:[a]		
Parameter	50% of Time	10% of Time	Six Month Median[b]
Arsenic	0.01	0.02	0.008
Cadmium	0.02	0.03	0.003
Chromium, total	0.005	0.01	0.002
Copper	0.02	0.3	0.005
Lead	0.1	0.2	0.008
Mercury	0.001	0.002	0.00014
Nickel	0.1	0.2	0.02
Silver	0.02	0.04	0.00045
Zinc	0.3	0.5	0.02
Cyanide	0.1	0.2	0.005
Phenolic compounds	0.5	1.0	0.3
Total chlorine residual	1.0	2.0	0.002
Ammonia nitrogen	40.0	60.0	0.6
Toxicity	1.5[c]	2.0	0.05
Total identifiable	0.002	0.004	0.002[a]
Radioactivity	Limits specified in Title 17, Chapter 3, Subchapter 4, Group 3, Article 5 Sections 30285 and 30287 of Calif. Adm. Code		Limits specified in Section 30269 of the Calif. Adm. Code

[a] Standards have been applied directly to waste stream.

[b] Limits in receiving water upon completion of initial dilution except total identifiable chlorinated hydrocarbons and radioactivity which are applied to waste stream.

[c] Toxicity units.

It is apparent that as research methods improve,adverse effects of toxic materials on aquatic organisms are detectable at lower concentrations. For this reason the toxic materials concentration limits in the Ocean Plan have been reduced. However, because it is now permissible to take credit for initial dilution and most ocean discharges can readily obtain an initial dilution of at least fifty to one the net effect of the amendments is to make life easier for ocean dischargers.

The significance of the amendments in relation to Bay discharges is unclear. Current discharge permit conditions are based on the original ocean plan limitations. The Regional Board has not yet determined whether it will modify the permits to be consistent with the Ocean Plan amendments.

Compliance with Existing Regulation

The self-monitoring results of all municipal discharges with an average dry weather flow greater than 5 mgd or with a known significant industrial comonent were reviewed. Table 3 summarizes the compliance of individual discharges in 1975 with limits on toxic materials in the effluent. Only three dischargers, Hayward, VCSD and Burlingame did not violate toxic material limits. All three have industrial waste discharges to their sewer systems.

All other surveyed dischargers violated one or more effluent limits on toxic materials. The greatest number of violations occurred for total chromium where 86 percent, or 24 dischargers, exceeded their limit. Nine dischargers, or 37 percent of the violators, had chromium as the only excess metal in their effluent.

Excess effluent concentrations of other toxic materials occurred for the following numbers of dischargers:

Toxic Material	Number of Violations of NPDES Limits
Arsenic	4
Cadmium	2
Chromium	24
Copper	2
Lead	5
Mercury	6
Nickel	6
Zinc	7
Cyanide	0
Phenols	1
Identifiable Chlorinated Hydrocarbons	2

The greatest frequency of toxic materials violations occurred in treatment plants employing only primary sedimentation. Secondary biological treatment removed more but not all of the toxic materials.

Compliance with A Regulation Based on the Amended Ocean Plan

It seems possible that, in the future, discharge permits might be written based on the toxic materials limits contained in the amended ocean plan. A rough calculation was made to determine to what degree this change in limits might affect compliance.

The values of the new limits were arbitrarily multiplied by a factor of 10 to represent dilution within the Bay system and a factor of 50 to repsent dilution in the ocean. Then these limits were compared to the quality of municipal discharges reported for 1975. The following numbers of violations would occur under these conditions:

Toxic Material	Number of Potential Discharge Violation
Arsenic	0
Cadmium	1
Chromium	16
Copper	10
Lead	8
Mercury	5
Nickel	4
Zinc	7
Cyanide	2
Phenols	0
Identifiable Chlorinated Hydrocarbons	0

Table 4 presents specific potential violations.

The most significant changes would occur for arsenic, chromium, copper and lead. Arsenic and chromium violations could occur less frequently while copper and lead limits may be exceeded more frequently. Copper and lead may be particularly difficult to reach through source control if the principle sources turn out to be domestic plumbing fixtures.

The estimated potential violations listed above are based upon a limited, non-site specific criterion. In reality, each discharger would be able to achieve different initial wastewater dilutions in the receiving water. An effective outfall diffuser achieving higher dilutions than those estimated could permit increased toxic material concentrations in the effluent.

SOURCE CONTROL PROGRAMS

Local source control programs are mandated by Section 307 of the Federal Water Pollution Control Act and Section 13 379(h) of the California Water Code. Also, regulations adopted by the State Water Resources Control Board (SWRCB) require operators of publicly owned treatment works to have and enforce an adequate source control program.

Table 3: 1975 COMPLIANCE OF SELECTED DISCHARGERS WITH 1972 OCEAN PLAN LIMITS FOR TOXIC MATERIALS

Violations are indicated with an X

Sewerage Unit - Discharger	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Cyanide	Phenols	Identifiable Chlorinated Hydrocarbons
Over 5 mgd ADWF											
11 - Napa			X								
12 - Vallejo	X	X	X	X	X						
14 - Fairfield-Suisun			X								
18 - CCCSD			X								
22 - San Pablo S.D.	X										
23 - Richmond			X								
24 - EBMUD			X	X	X			X		X	X
25 - San Leandro			X			X					
26 - Oro Loma			X				X				
27 - Hayward											
28 - Union S.D. - Alvarado			X		X	X	X				
29 - Union S.D. - Irvington			X				X	X			
30 - Union S.D. - Newark			X				X	X			
32 - VCSD											
33 - San Jose			X								
34 - Sunnyvale			X								
35 - Palo Alto			X			X					
36 - Menlo Park			X								
37 - Redwood City			X			X					
38 - San Carlos - Belmont			X		X		X	X			
40 - San Mateo			X								
43 - South San Francisco			X								
48 - San Francisco - Northpoint	X		X								
49 - San Francisco - Sunset			X			X					
50 - San Francisco - Southeast			X		X	X		X			
Others with significant industrial flow											
17 - CCCSD - 7A	X	X	X					X			X
31 - Livermore			X				X	X			
41 - Burlingame											

Source: 1975 self-monitoring reports on file with RWQCB.

Table 4: 1975 COMPLIANCE OF SELECTED DISCHARGERS WITH 1978 OCEAN PLAN AMENDED LIMITS FOR TOXIC MATERIALS[a]

Potential violations are indicated with an X

Sewerage Unit - Discharger	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Cyanide	Phenols	Identifiable Chlorinated Hydrocarbons
Over 5 mgd ADWF											
11 - Napa			X								
12 - Vallejo		X	X	X	X						
14 - Fairfield-Suisun			X								
18 - CCCSD				X							
22 - San Pablo S.D.								X			
23 - Richmond			X					X			
24 - EBMUD			X	X	X			X			
25 - San Leandro			X			X					
26 - Oro Loma											
27 - Hayward									X		
28 - Union S.D. - Alvarado			X		X	X	X				
29 - Union S.D. - Irvington			X	X	X		X				
30 - Union S.D. - Newark			X				X				
32 - VCSD											
33 - San Jose			X	X							
34 - Sunnyvale											
35 - Palo Alto			X	X		X					
36 - Menlo Park			X								
37 - Redwood City						X					
38 - San Carlos - Belmont			X	X	X		X	X			
40 - San Mateo				X							
43 - South San Francisco			X						X		
48 - San Francisco - Northpoint				X	X						
49 - San Francisco - Sunset											
50 - San Francisco - Southeast			X		X	X		X			
Others with significant industrial flow											
17 - CCCSD - 7A			X		X			X			
31 - Livermore				X				X			
41 - Burlingame											

[a] Assumed Bay system discharge dilution of 10X and ocean discharge dilution of 50X.

SWRCB Guidelines

The SWRCB has produced a document to help local agencies establish source control programs. The SWRCB's Guidelines for Determining Effectiveness of Local Source Control Programs are advisory and are not strictly enforceable. However, they are the most authoritative document on source control programs issued by the SWRCB to date, and help to determine the effectiveness of local source control programs in the 208 planning area.

The SWRCB's Guidelines outlines the key features that should be included in every local source control program. These features are:

"1. Adoption of a local source control ordinance (industrial waste ordinance or pretreatment ordinance).

2. A program of issuance of use permits.

3. A program of surveillance.

4. A program of correction including applicable enforcement measures."

The local wastewater treatment facilities in the Bay Area have varying numbers and classes of industrial dischargers within their jurisdictions. The relationship between the agency owning the treatment works and the dischargers within the collection system can also vary. To accommodate these variations, the local source control programs should be developed on a case-by-case basis.

Regional Board Requirements

The SWRCB's Guidelines state that "each local sewerage agency providing sewerage service, where the average dry weather flow is 5 mgd or more, or where the State Board or a Regional Board deems appropriate, should enact a source control ordinance.: The Regional Water Quality Control Board, San Francisco Bay Region requires virtually all municipal dischargers to have a source control program or demonstrate that there are no industrial inputs to the sewer system. This requirement is put forth as an NPDES permit condition for each discharger. Only a handful of dischargers have chosen to demonstrate no input. Of the major dischargers, with an average dry weather flow in excess of 5 mgd, only the City of San Mateo does not have a source control ordinance because they do not have industrial dischargers.

Effectiveness of Existing Programs

In a previous section of this memorandum municipal dischargers' 1975 reported effluent quality was compared with NPDES permit effluent requirements. Table 3 demonstrated a substantial degree of non-compliance with the requirements for toxic materials. This does not mean that present practices are necessarily ineffective for several reasons.

Most Bay Area source control ordinances were adopted in the period 1974 through 1976. These ordinances have time schedules for implementation and additional schedules for compliance by contributing industries. The full effectiveness of these ordinances cannot be measured by the 1975 discharge data, or even 1977 discharge data. If will remain for the continuing planning process to evaluate the effectiveness of the various programs two or three years hence.

Many municipal dischargers are in the process of upgrading their treatment systems. Those with only primary level treatment were identified as having the greater number of excess toxic materials in the treated effluent. All dischargers are currently constructing or commencing operations on secondary level biological or physical-chemical treatment systems. Their effluents can be expected to improve substantially and should be reevaluated for toxic materials after a reasonable period of operation.

The current investigation can only establish whether source control programs have been adopted by the surveyed agencies and if these programs conform to the basic guidelines promulgated by the SWRCB.

Table 5 presents the results of the source control program survey. The overwhelming majority of the municipal dischargers have source control programs that basically conform to SWRCB guidelines. A number of dischargers, principally municipalities, with ordinances or regulations adopted prior to 1974 have general sewer use or building code regulations. These regulations do not specifically address themselves to the NPDES permit conditions. I requires some imagination to use these older regulations for source control. However, this should not imply that effective source control cannot be accomplished with them. The SWRCB guidelines are just that--guidelines--and municipal dischargers have some freedom in determining their own best approach to source control. The final and only relevant criterion for judgment is whether a municipal discharger satisfies the NPDES permit requirements.

In regard to the fact that many dischargers are currently upgrading wastewater treatment it should be noted that biological secondary level treatment cannot remove all toxic materials, particularly metals from the effluent streams. This is evidenced by excess metals in the effluent streams from existing secondary level facilities. Biological treatment systems, such as activated sludge, are effective in removing lead and zinc, moderately effective for metals such as copper and cadmium and marginally effective for chromium and nickel. Thus source control programs will still be necessary for sewerage agencies employing biological treatment. If reclamation and reuse of sludge is planned, then source control would be needed to prevent heavy metal concentrations in the sludge.

Those treatment plants employing chemical precipitation of toxic materials can be expected to remove a large percentage of the toxic materials. It might be possible for some plants to remove enough materials to eliminate the need for a source control program. Other facilities may need carbon

TABLE 5. SOURCE CONTROL PROGRAMS OF SELECTED MUNICIPAL DISCHARGERS

Sewerage Unit	Date of Ordinance or Regulation	Discharge Permit Required	No. of Permits Issued	Estimated No. of[a] Substantial Industrial Contributors	Agency Has Power to Inspect and Monitor	Agency May Require Self-Monitoring	Agency Has Procedures For Correction of Violations and Enforcement
11 - Napa	6/13/77	No	0	3	Yes	Yes	No?
12 - Vallejo	5/12/75	Yes	n.a.	7	Yes	Yes	Yes
14 - Fairfield-Suisun	6/23/76	Yes	n.a.	3	Yes	Yes	Yes
17 - CCCSD-7A	None	No	0	1	No	Yes	No
18 - CCCSD	7/11/74	Yes	11	11	Yes	Yes	Yes
22 - San Pablo S.D.	1/12/71	Yes	0	~30	Yes	No	Yes
23 - Richmond	6/6/60	Yes	n.a.	47	Yes	Yes	Yes
24 - EBMUD	1/1/73	Yes	~60	~2000	Yes	Yes	Yes
25 - San Leandro	10/12/75	Yes	n.a.	32	Yes	Yes	Yes
26 - Oro Loma	1/1/75	Yes	n.a.	n.a.	Yes	No	Yes
27 - Hayward	2/25/75	Yes	17	20 (300)	Yes	Yes	Yes
28,29,30 - Union S.D.	6/1/76	Yes	66	66	Yes	Yes	Yes
31 - Livermore	8/75	Yes	2	2	Yes	Yes	Yes
32 - VCSD	12/19/72	No	0	~6	Yes	Yes	Yes
33 - San Jose-Santa Clara	n.a.	Yes	0	n.a.	Yes	No	Yes
34 - Sunnyvale	9/21/76	Yes	n.a.	~250 (2000)	Yes	Yes	Yes
35 - Palo Alto	9/15/73	Yes	~77	~77	Yes	Yes	Yes
36 - Menlo Park	11/10/75	Yes	22	22	Yes	Yes	Yes
37 - Redwood City	11/11/75	Yes	8	8	Yes	Yes	Yes
38 - San Carlos-Belmont	--/75	Yes	n.a.	14	Yes	Yes	Yes
40 - San Mateo	NO SOURCE CONTROL ORDINANCE			0			
41 - Burlingame	10/15/70	No	0	~10	No	Yes	Yes
43 - So. San Francisco	4/1/74	Yes	25	>25	Yes	Yes	Yes
48,49,50 - San Francisco	6/8/77	No	~700	~700	Yes	Yes	Yes

Note: [a]Numbers reported varied from total industries to critical industries only. When two numbers are presented, smaller is critical, larger in paren. is total.

n.a. = not available.

absorption columns for adequate removal of difficult materials such as hexavalent chromium. Recent studies have shown that the toxic metal residuals following lime precipitation and carbon absorption treatment of wastewater may still exceed ocean plan standards.[a] Thus, in general, it can be assumed that source control programs will still be necessary for the majority of wastewater treatment agencies in the Bay Area.

PROPOSED PRETREATMENT STRATEGY

As noted earlier it is difficult to argue for a stringent program of toxicant controls in view of the dearth of hard evidence of harm to the environment. The recommended control strategy involves concurrent programs of information gathering and control actions only where they can be accomplished at a relatively low cost. The two sources of toxic materials that appears to be most cost-effective to control are industrial discharges to municipal sewer systems and surface runoff. Little is being done at present to control surface runoff. If implemented the surface runoff control plans prepared by the counties as part of the EMP will be a modest step toward low-cost controls. On the other hand point source discharges which account for only a small proportion of the metals emitted to the bay are already regulated fairly stringently by the Regional Water Quality Control Board.

It appears that the best strategy for the region with regard to pretreatment is to continue the present program of prescribing toxicant limits for municipal discharges based on the Ocean Plan, thus requiring pretreatment only where it is necessary to meet the limits. The environmental benefits of arbitrarily requiring higher levels of pretreatment are not demonstrable. This strategy would be reviewed in the future as more information becomes available.

It should be noted, however, that the region's ability to adopt the recommended strategy may be preempted if EPA, at the conclusion of its current deliberations, decides that nationwide uniform pretreatment requirements are desirable.

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[a] Reference: Maruyama, T., S.A. Hannah, J.M. Cohen, "Metal Removal by Physical and Chemical Treatment Processes," Journal Water Pollution Control Federation, 47, p. 962 (May 1975).

WATER QUALITY MANAGEMENT PLAN

AN ESTIMATE OF THE ECONOMIC VALUE OF SHELLFISH IN SAN FRANCISCO BAY

TECHNICAL MEMORANDUM NO. 32

JANUARY, 1978

Introduction

In a report to the U.S. Congress, the National Marine Fisheries Service identified problems and opportunities of the shellfish industries (1). The shellfish resource continues to decline through loss or degradation of shellfish beds as a result of competition for use of the coastal zone, pollution, jurisdictional authorities and regulations. All these translate to loss of employment, higher prices of shellfish to consumers and the dwindling of a valuable and renewable resource. This downward trend should be halted and reversed, the report concluded.

The shellfish resources of San Francisco Bay is abundant and widespread, according to a recent study conducted for ABAG's Environmental Management Plan (2). However, all shellfish harvesting for human consumption is prohibited due to potential and actual contamination by pathogenic bacteria. Recent improvements in water quality of the bay has generated considerable interest in reestablishing both recreational and commercial shellfish harvesting. The difficulties in achieving that goal are described in the report mentioned above (2).

An important question that begs to be answered is "What is the economic worth of the shellfish resource in San Francisco Bay?"

There are six species of shellfish in the bay that have economic value:

- soft-shell clam (*Mya arenaria*)
- Japanese littleneck clam (*Tapes japonica*)
- native oyster (*Ostrea lurida*)
- eastern oyster (*Crassostrea virginica*)
- bay mussel (*Mytilus edulis*)
- California mussel (*Mytilus californianus*)

Clams

According to estimates by a shellfish expert (Walt Dahlstrom) at the California Department of Fish and Game (DFG), there are over 26 million adult softshell clams and 13.4 million adult Japanese littleneck clams in the bay (3). He believes that a systematic and comprehensive survey may reveal even larger populations, especially if deeper waters are included. Furthermore, he says that clam populations can be increased significantly if more suitable substrate and some protection from natural predators are provided.

39.4 million adult clams can support substantial recreational harvesting, given the current limit of 50 clams per person per day (DFG legal limit). Biologists believe that at least 50% of the adult clams can be harvested annually without depleting the populations. Therefore, the annual sustainable yield would be about 20 million clams. This would provide 400,000 clam-digging days per year or allow 1,096 persons catching their limit everyday of the year. At present, there is an average of 28 persons digging for clams at one of the largest and most accessible clam beds near Foster City (3).

It is difficult to estimate the monetary worth of recreational clam-digging and so far no such study has been done.

The current retail price of fresh clams is $1.50 to $2.00 per pound (about 15 clams/lb.) Therefore, the cost of 20 million clams is approximately $1.9 to $2.6 million. The Stanford Research Institute, in a study dated 1966 (4), estimated that the recreational worth of pier-fishing in the Bay Area was $3 to $5 per person per day which is equivalent to $5.25 and $8.75 today. If we assume that the recreational worth of clam-digging is comparable to pier-fishing (there are a number of important similarities between these two activities), then the recreational value of clam-digging is worth $2.1 to $3.5 million annually.

The potential for commercial clam fishing appears to be promising especially in deeper waters and less accessible beds where it will not conflict with recreational clam-digging. Its economic worth has not been determined.

Oysters

There are scattered oyster beds around the bay but none that could withstand heavy harvesting. The development of an oyster fishery is dependent on mariculture. DFG biologists (5) estimated that the bay has the biological capacity to support an oyster fishery capable of yielding 1.7 million gallons of shucked oysters (with shells removed) annually. Actual production would depend on social and economic constraints. At the current wholesale price of $12 to $15 per gallon of shucked oysters, an oyster industry producing 1.7 million gallons would be worth $20 to $25 million annually. This would account for a 20 percent increase over the total 1975 U.S. oyster sales (6).

Mussels

There are large populations of mussels both in and outside the bay, but it is doubtful that they can withstand intensive commercial harvesting. Therefore, a mussel fishery is also dependent on mariculture. One of the obstacles to the establishment of a mussel fishery is the uncertainty of the demand. Unlike many Europeans and Asian/Pacific Islanders that regard mussels as a delicacy, most Americans have not developed a taste for this seafood (7). However, recently mussels are being imported from Maine for sale in local restaurants and fish markets, retailing at about $1.70 per pound. This indicates that there may be a potentially growing market for mussels and its economic worth has yet to be explored.

Summary

There are six species of shellfish in San Francisco Bay that have economic value. According to best available estimates, there are vast numbers of clams scattered throughout the bay and they can support substantial recreational harvesting, worth $2.1 to $3.5 million annually. The great economic value of shellfish in the bay lie in commercial mariculture of clams, mussels and oysters. The monetary worth of clams and mussels has not been explored but they both appear promising. The economic value of oysters is estimated to be worth $20 to $25 million annually.

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WQ/Tech Memo 33/January, 1978
R. Wong/P. Wong/M. Goldman

WATER QUALITY MANAGEMENT PLAN

WATER QUALITY PROBLEMS IN SAN FRANCISCO BAY

TECHNICAL MEMORANDUM NO. 33

JANUARY, 1978

The Draft Environmental Management Plan identified a number of water quality problems in the San Francisco Bay Region, as represented in the accompanying map. These problems are:

Shellfish Contamination

The shellfish resource in the bay is widespread and abundant but harvesting for human consumption is prohibited due to contamination by bacteria and perhaps, virus and heavy metals. Sources of contamination include surface runoff, sewage discharge and vessel wastes.

Fish Kills

Fish kills, including the popular striped bass, occur annually in many parts of the bay and its tributaries. However, causes for these mortalities remain, more or less, a mystery.

Septic Tanks

Improperly planned, designed, installed or maintained septic tanks and drain fields scattered in various parts of the region pollute ground and surface waters.

Vessel Wastes from Marinas

Numerous small crafts in many marinas around the bay discharge raw or poorly treated sewage causing bacterial pollution problems, e.g. shellfish contamination and prohibition of swimming.

Salt Water Intrusion

Saline water intrudes into groundwater in several areas as a result of pumping.

Surface Runoff

Seven major types of water quality problems associated with surface runoff have been identified:

- sedimentation and erosion
- bacterial contamination
- heavy metals, pesticides and other toxic compounds
- oil and grease
- litter and debris
- nutrients and algal growth
- organic wastes and low dissolved oxygen

These problems are persistent or chronic rather than critical; they are widespread--155 specific locations having these problems have been identified.

Toxicants

There is some evidence suggesting that certain toxic chemicals are adversely affecting aquatic species in the bay such as premature births of harbor seals, egg shell thinning of some birds, abnormal growths in mussels and the decline of dungeness crabs. These phenomena are subtle indicators of ecological disruptions which are often difficult to detect and usually are accumulative and long term in nature. In other words, there are many effects, especially chronic ones, of environmental pollution that cannot be ascertained unequivocally. Some of these uncertainties can be unraveled by more research but others will probably never be resolved in a manner satisfactory to all.

Delta Outflow

Changes in the outflow of the Sacramento-San Joaquin Delta will affect San Francisco Bay in the following areas:

- changes in biological communities such as phytoplankton productivity and the diversity and abundance of fish,
- alterations in the stratification, and therefore, circulation in the South Bay,
- agricultural drainage from the San Joaquin Valley will add a considerable quantity of salts and nitrogenous material to the bay.

The extent, magnitude and/or biological impact of these changes have yet to be assessed.

Oil and Chemical Spills

Oil and chemical spills continue to occur periodically creating hazardous or fatal conditions for aquatic life.

WATER QUALITY MANAGEMENT PLANS

WATER QUALITY ANALYSIS AND POLLUTION CONTROL STRATEGIES

Issue Paper No. 1
15 December, 1976

The purposes of this paper are threefold:

- to describe how pollution cause-and-effect relationships are analysed
- to outline the development of control strategies to date
- to pose several questions concerning future control strategies.

Water quality analysis

The polluted condition of a water body usually results from the introduction of foreign material into the water body. Because it is rarely possible to completely eliminate the discharge of pollutants it becomes important to know how much pollutant material the water body can assimilate without adverse effects. To answer this question a water quality analysis is undertaken. The precision of the analysis is not great, however, and consequently safety factors must be introduced into the calculations.

The analysis proceeds in a number of steps:

1. Establish beneficial uses. The uses that it is desirable the water body should support are identified.

2. Establish water quality standards. Quality standards are set for the water body which will allow the desired beneficial uses to occur. Where technically possible the standards are expressed numerically and are based on the body of scientific data that pertains to water quality requirements for different uses.

3. Inventory pollution sources and estimate pollutant mass emission rates.

4. Analyse environmental response to pollutant loads. Using available information on the chemical, physical and biological response of the water body to introduced pollutants a predictive model is developed that will simulate this response. The complexity of pollution cause-and-effect relationships is such that the model is usually installed on a computer.

5. Estimate assimilative capacity. Using the model the pollutant mass emission rate that will just allow compliance with the established water quality standards is determined. The allowable pollutant mass emission, adjusted by a safety factor that takes account of the imprecision of the analysis, then becomes the target of control strategies.

Although this sequence of steps is logical it suffers from a major deficiency. Step 4, the analysis of the pollution cause-and-effect relationship, is based on a limited and in some cases clearly inadequate understanding of the environmental response of water bodies to introduced pollutants. This weak link in the chain reduces the utility of the water quality analysis. Thus the analysis must be regarded as an aid to decision-making rather than a precise analytical tool.

In the Bay Area extensive water quality analyses of the Bay-Delta system have been performed--most recently in the courses of studies, supporting the development of the water quality control or basin plan. The analyses have been largely directed toward consideration of dry weather conditions, that is conditions when the Bay is effected by municipal and industrial wastewater discharges and non-runoff related diffuse pollutant sources such as aerial fall-out. In the course of the 208 program two conditions will be considered. First, the dry-weather analysis will be refined and secondly wet-weather conditions will be analysed. In the latter condition the Bay is impacted by municipal and industrial discharges and both runoff and non-runoff related diffuse sources.

Control strategies can then be developed for both wet and dry-weather conditions.

Development of Control Strategies

Prior to the passage of the Federal Water Pollution Control Act Amendments of 1972 (PL92-500) most water pollution control legislation concentrated on the establishment of water quality standards and the procedures for penalizing dischargers that caused violations of the standards.

Few attempts were made to directly regulate quality of discharged wastewater at the end of the pipe by establishing effluent limitations. As a consequence much effort was expended on water quality analyses in an attempt to establish the relationship between individual dischargers and the quality of the receiving waters as a prerequisite to the determination of treatment needs. In view of the technical uncertainties surrounding environmental response to introduced pollutants it is hardly surprising that controversies abounded. The controversies, in concert with the lack of public concern for environmental values that prevailed prior to the late sixties, resulted in only limited progress toward pollution control goals.

In an effort to circumvent this problem the authors of PL92-500 radically departed from the earlier approach and refocused regulation on the quality of waste as it emerged from the pipe regardless of the characteristics of the receiving waters. Thus all discharges must be of a specified improved quality before discharge can be permitted.

The new approach to regulation meant that since a certain level of treatment was mandatory and not subject to technical argument pollution control projects could be rapidly and relatively easily implemented. Ease of implementation has a price however. Because the effluent requirements were set uniformly nationwide they are inevitably arbitrary and in some cases inappropriate. For example many authorities believe that the money invested in providing secondary treatment prior to discharge of waste to the ocean reaps few if any environmental benefits.

One of the goals of the water quality analysis undertaken in the basin plan was to determine which water bodies in the Bay Area will remain in violation of water quality standards after the effluent limitations contained in PL92-500 are put into effect. It was determined that in the Bay itself under dry weather conditions only the South Bay would violate water quality standards. Further control measures are necessary in these areas.

The questions must now be asked whether the existing control strategies are adequate to accomplish the objectives of the Environmental Management Plan or is further strategic development needed. It is apparent that the present strategy for control of point discharges based on the dry weather water quality analysis is effective. Work undertaken as part of the Environmental Management Plan will represent a continuation and refinement of this strategy. In the case of wet weather conditions however, no strategy presently exists. The following section of this paper describes a number of alternative wet-weather control strategies and proposes a strategy for use in the Environmental Management Program.

Wet-Weather Control Strategies

Three basic control strategies are apparent

1. Complete reliance on water quality standards

   This strategy is analagous to that used to control municipal and industrial discharges prior to the passage of PL92-500. Under this strategy the following sequence of events might take place. A violation of water quality standards is noted near the outlet of a storm sewer that drains an urban watershed. The city within which the watershed lies is informed by the regulatory agency that the discharges must be altered to prevent the violation. A period of controversy ensues while the city carries out studies and argues with the regulatory agency regarding the seriousness of the problem and the measures may or may not be implemented but in any event nothing happens very rapidly.

   This strategy has the advantage of making good sense technically. Its disadvantage is that it is difficult and slow to implement.

2. <u>Arbitrary enforcement of control measures regionwide</u>

This strategy would involve the imposition of certain arbitrary controls throughout the region. The controls might be expressed in a number of ways, by mandating certain frequencies of street cleaning or design details for catch-basins and other drainage structures, or by specifying that the total mass emission of pollutants from urban runoff be reduced by a certain percentage. Regardless of the means of expression this strategy is arbitrary and inevitably involves expenditures for control measures that accrue no, or at least questionable, environmental benefits. The advantage of this strategy is that it is easy to implement provided the designated regulatory agency has the power to enforce it.

3. <u>Arbitrary enforcement of certain minimal control measures with reliance on water quality standards in areas that continue to have quality problems after the minimal control measures are implemented</u>.

This strategy is analagous to the strategy adopted by EPA in implementing PL92-500 to control municipal and industrial discharges. A certain minimum level of control is imposed arbitrarily. Rapid progress is made with implementation and the more obvious and easily and cheaply corrected problems are taken care of. In areas in which problems persist, additional controls are applied based on a water quality analysis and a demonstration of benefits to be accrued.

Which of these strategies to adopt is a question that must be resolved in the near future.

It is the belief of ABAG staff's and the EPA project officer that the third alternative wet-weather control strategy is most promising. The arbitrary minimum level of control will be defined in consultation with each of the counties developing a surface runoff management plan.

WATER QUALITY MANAGEMENT PLANS

PRETREATMENT OF INDUSTRIAL WASTES
DISCHARGED TO MUNICIPAL SEWER SYSTEMS

Issue Paper No. 2
14 January, 1977

Preface: This issue paper should be read in conjunction with Water Quality Management Plans Technical Memorandum No. 2 dated October 12, 1976 and entitled, "Review of Existing Laws, Policies, and Requirements for the Pretreatment or Treatment of Industrial Wastes."

INTRODUCTION

Pretreatment is the term used to describe the treatment of industrial wastes prior to their discharge to a municipal sewer. Section 307 (b)(1) of the Federal Water Pollution Control Act (PL 92-500) states that "The Administrator (of EPA) shall,....publish proposed regulations establishing pretreatment standards for introduction of pollutants into treatment works....which are publicly owned, for those pollutants which are determined not to be susceptible to treatment by such treatment works or which would interfere with the operation of such treatment works." Ninety days after publication, and after opportunity for public hearing, final regulations shall be promulgated.

Progress toward a complete definition of pretreatment requirements has been slow and will not be completed before the Environmental Management Plan is completed. A number of issues remain to be resolved and are undergoing study by an EPA task force. This paper describes some of these issues and proposes an approach for management of non-discrete industrial dischargers that may be used in the Environmental Management Plan.

Before discussing the regulation of non-discrete industrial dischargers, it is worth reviewing the philosophy underlying the regulation of discrete industrial dischargers.

REGULATION OF DISCRETE DISCHARGERS

The Federal Water Pollution Act Amendments of 1972 (PL 92-500) specifies effluent limitations for all discrete industrial dischargers:

> "not later than July 1, 1977, effluent limitations for point sources, other than publicly owned treatment works....shall require the application of best practicable control technology currently available...."

"not later than July 1, 1983, effluent limitations for categories and classes of point sources, other than publicly owned treatment works....shall require application of the best available technology economically achievable for such category or class...."

"Best practicable control technology currently available" represents the average of best existing waste treatment performance within each industry category or subcategory. "Best available technology economically achievable" will be based on the very best control and treatment measures that have been developed or are capable of being developed within the appropriate industrial category or subcategory. In meeting the two deadlines, dischargers are required to treat their wastes to a degree made possible by the two technologies, but are not required to use any particular method or process of pollution control.

The procedure for establishing effluent limitations for particular industrial categories is described fully in a recent EPA publication ("No Small Task; Establishing National Effluent Limitation Guidelines and Standards" June, 1976). The information necessary to establish guidelines and standards for each industrial category is contained in two documents for each category, "Development Document for Effluent Limitations Guidelines and New Source Performance Standards" and "Economic Analysis of Effluent Guidelines." After widespread distribution and review of these documents, which take account of such factors as the cost of pollution control, the age of industrial facilities, manufacturing processes employed, environmental impact of water pollution controls and energy consumption, EPA promulgates effluent limitations.

A most significant feature of the effluent limitations is that they are based solely on technological and economic factors and take no direct account of quality conditions in the water body receiving the discharge. Provision is made, however, to make the effluent limitations more stringent in the event that implementation of technology-based standards does not solve water pollution problems.

EQUITY CONSIDERATIONS

Equity considerations enter into the regulation of both discrete and nondiscrete dischargers. In the case of discrete dischargers the principal reason for the uniform imposition of technology-based effluent limitations was to avoid the delays in implementation that would inevitably plague a pollution control program based on case-by-case analysis of water quality conditions. However, a secondary consideration was that the costs of pollution control should fall equally on all factories within a particular industrial category regardless of geographical location. Although this latter consideration makes little sense from an environmental point of view, uniform regulation discourages industrial relocation in search of less stringent regulation.

Equity considerations are more obviously spelled out in PL92-500 with regard to cost recovery from industrial users of municipal wastewater systems. Section 204 (b)(1) of the Act states that "The Administrator shall not approve any grant for any treatment works....unless he shall first have determined that the applicant (A) has adopted or will adopt a system of charges to assure that each recipient of waste treatment services....will pay its proportionate share of the costs of operation and maintenance (including replacement) of any waste treatment services provided by the applicant; (B) has made provision for the payment to such applicant by the industrial users of the treatment works, of that portion of the cost of construction of such treatment works....which are allocable to the treatment of such industrial wastes to the extent attributable to the Federal share of cost of construction...."

Thus it can be seen that equity between municipal and industrial users of a wastewater management system and equity between discrete discharging industries at different locations has been a factor in drafting existing laws and regulations.

REGULATION OF NON-DISCRETE DISCHARGERS

Progress to date

In November 1973, EPA issued a general regulation (40 CFR 128) for pretreatment standards. The regulation defined "compatible pollutants" as BOD, suspended solids, pH and fecal coliform bacteria, together with any other pollutants which a publicly owned treatment works has been designed and operated to handle. "Incompatible pollutants" are all those not compatible. The regulation does not require pretreatment for removal of compatible pollutants, although local agencies or states may so require, but does make major industries the subject of effluent limitations for non-compatible pollutants. At the time of issuance, the intent was that EPA would rapidly promulgate pretreatment standards for each industrial category.

For existing sources, EPA has promulgated standards for roughly one-third to one-half of the industrial categories. The standards issued are essentially all for industries that do not emit incompatible pollutants. Standards for existing sources of incompatible pollutants remain to be issued.

For new sources, EPA had issued pretreatment standards that correspond with new source standards for discrete dischargers once an allowance has been made for removal of incompatible pollutants at the municipal treatment plant.

THE EMP AND PRETREATMENT

As noted earlier, EPA has formed a task force to study alternative approaches to regulation of existing non-discrete dischargers. The results

of the task force's deliberations will not be known until after the EMP is complete. This presents two problems to the EMP staff; how to develop an overall strategy without knowing EPA's plans for the future and how to make estimates of future waste loads.

The first problem can be solved by developing a regional plan for regulation of non-discrete sources that can accommodate EPA's regulations whatever they may be. This will require some analysis of the extremities of EPA's range of alternatives.

The second problem relates to the need for making certain estimates of future pollutant mass emission rates that will be affected by the pretreatment standards. This can best be handled by making a "most probable" estimate and subjecting the conclusions of any analyses based on the "most probable" estimate to a sensitivity analysis.

THE ALTERNATIVES

A number of alternative strategies for regulation of existing non-discrete sources are being considered by EPA's task force. The strategies that represent the boundaries of what is being considered are described below. Two intermediate strategies are also being considered.

1. Technology-based standards. These standards would be essentially identical with those for discrete dischargers except that some credit for removal at the municipal treatment plant would be given. This approach stems from a vigorous interpretation of the statement in the discussion preceding 40 CFR 128 that "The fact that a discharger chooses to use a municipal sewer system, rather than discharging his wastes directly to the navigable waters, should not as a matter of general principle involve a penalty to the environment." This strategy has the following advantages:

   - parity between discrete and non-discrete dischargers
   - easy to implement
   - consistency with philosophy of setting standards based on technological capabilities

   and disadvantages:

   - may impose disproportionately high economic penalty on the type of small industry prevalent in the older urban areas
   - not directly linked to a clear environmental benefit

2. Standards based on the downstream municipal wastewater treatment plant's effluent requirements (NPDES permit conditions)

   This strategy is based on the premise that the municipal treatment plant permit conditions adequately protect the environment.

It follows that pretreatment of tributary industrial wastes is only needed insofar as it allows compliance with effluent requirements and protects the integrity of the municipal treatment processes. This approach is being used by the East Bay Municipal Utility District in their source control program. It allows the non-discrete discharger to take advantage of the dilution available in the sewage collection system (see figure).

- o less expensive to comply with than technology-based standards
- o does not penalize small, older urban industries
- o encourages industry to remain in existing urban areas which may be socially and environmentally desirable
- o linked more closely to demonstrable environmental benefit than technology-based standards.

and disadvantages:

- o may unjustifiably favor non-discrete dischargers
- o more difficult to implement than technology-based standards
- o depends on the existence of environmentally-sound effluent limitations for the municipal treatment plant
- o may unjustifiably favor large municipalities in recruiting new industries by virtue of the high dilution availability in their collection system.

PROPOSED EMP APPROACH

It is proposed by EMP staff that an approach is adopted which will allow an evaluation to be made of the two boundary conditions prior to adopting a regional strategy. The proposed approach proceeds in a number of steps.

1. Review existing effluent requirements. The existing effluent limitations for municipal dischargers receiving industrial wastewaters will be reviewed to determine whether they are adequate to protect the environment and whether they are appropriate in the light of the mass emission rates of similar pollutants from other sources (e.g. urban runoff).

2. Tighten requirements if necessary.

3. Estimated mass emissions of metals. Estimates will be made of the mass emission of metals likely under this regulatory strategy and compared to that likely if technology-based standards are enforced.

4. Estimated costs and benefits. The costs of implementing a techonology-based standard will be estimated and compared to the benefits that might be derived from the reduction in mass emission of toxicants to the Bay.